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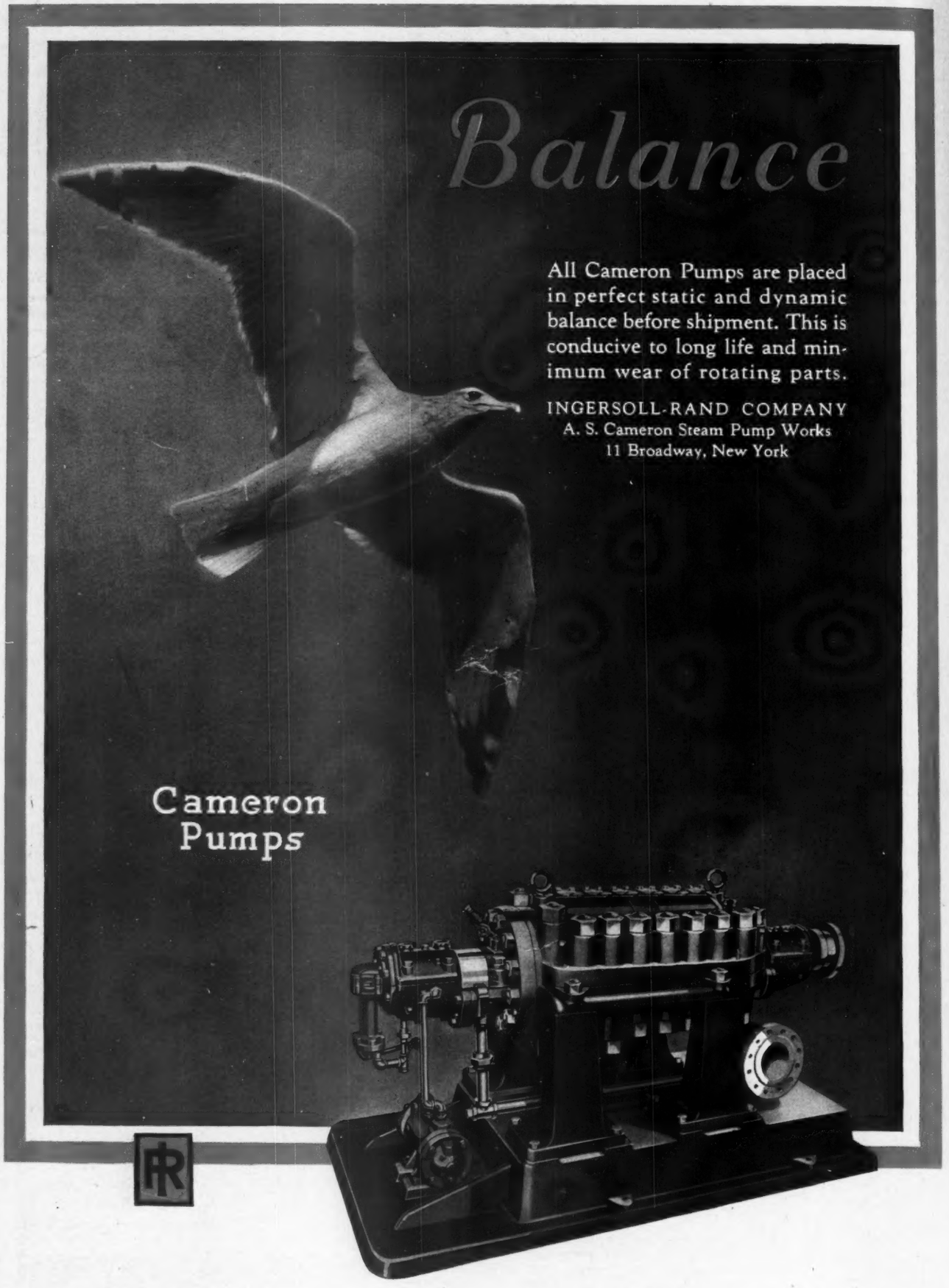
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ENGINEERING AND MINING JOURNAL

A consolidation of "Engineering and Mining Journal" and "Mining and Scientific Press"

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New York, April 6, 1929

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MAJOR ARTICLES form the pièce de résistance of the magazine. Some are written by the editorial staff, following personal surveys, but we look to operating mining engineers for co-operation in supplying material for most of them. Every reader owes it to himself and to his professional brothers to prepare an article occasionally on the subject in which he is a specialist, without waiting for an invitation from the Editor. Thus can one clarify his own thinking, add to his professional reputation and that of his company, and do a service to his fellows that will encourage them to reciprocate. Few, nowadays, will deny the advantages of such dignified publicity.

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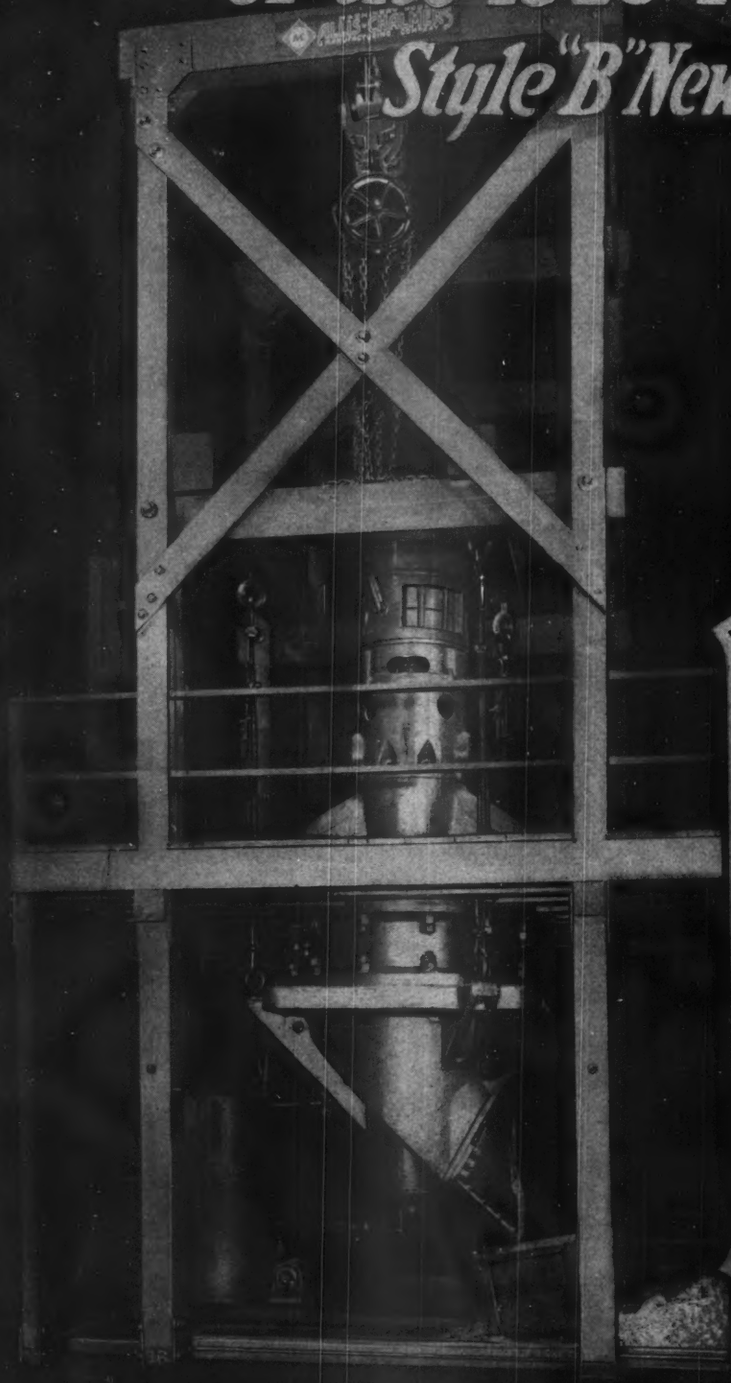
An Outstanding Feature of the 1929 Road Show

Style "B" Newhouse Crusher



VISITORS to the 1929 Road Show at Cleveland were impressed by the 10" Style "B" Newhouse Crusher on exhibit there. Some liked the rapid crushing action of this crusher, others remarked on the uniformity of product. The method of supporting the crusher from the framework of a building, eliminating expensive foundations, was attractive and also the fact that much of the vibration and shock of crushing was absorbed by the cables. It was hard to realize that a crusher could be so simple; there were no gears, pinions, pulleys, or belts, to cause trouble or wear out. The few working parts are lubricated through a positive oiling system that includes a filter to insure clean oil at all times.

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The Growing Importance of Intangible Profits

A FINANCIAL STATEMENT recently issued by a prominent New York bank concludes with the following paragraph: "Our listed resources, enumerated in this statement, do not and cannot include those assets of friendliness and helpfulness which this bank has in the personnel of its board of directors, its officers, and employees. These are assets which pay dividends to our patrons in service and satisfaction."

Assets of friendliness and helpfulness. A major trend of the times, of vast importance to the cause of industrial peace and social opportunity, is thus brought to one's notice; a trend, moreover, that the world is recognizing as long delayed. A few years ago such a claim as the one quoted would have been considered an example of brazen buncombe—as part of a scheme to capture more business. What has happened in the meantime? The answer is seen in the wider distribution of the stock of every progressive corporation, and the personal interest engendered even among the lowliest employees in the prestige as well as the profit gained by its business operations.

Industry in the past has been prone to disregard the broader interpretation of the word "profit," as used, for example in Holy Writ—"What shall it profit a man if he gain the whole world and lose his soul?" The corporation or business of today must have a soul, otherwise it will fail dismally in competition with the enterprise that first sets its house in order by securing internal harmony and satisfaction, and then molds its policies in a sincere effort to gain and to hold the esteem of the buying public. This public is quick to gage its estimate of a company by the attitude of its employees.

The time is rapidly approaching when intangible profit will receive more consideration than tangible profit, because the one builds for the future and the other is merely a financial record of the past. Publishing, for instance, connotes selling as well as printing; and selling, as distinct from exchange, infers profitable operations. The publisher's task, therefore, is to give such service to the industry, and to maintain an economic balance between that service and the cost involved, so that an adequate surplus is available for normal and healthy growth, and to insure a fair return to all concerned in the enterprise.

Monetary profit is tangible; reputational profit is intangible. A combination of the two should be the goal of all activities that seek a high standing in national or international opinion. If the word profit be applied to publishing, and the dictionary definition be used, profitable publishing means, in the order of definition: (1) Publishing for advancement, for advantage, for improvement, for the accession of good, for valuable results, for useful consequences, for benefit, for avail, for gain. (2) Publishing to insure excess of return over expenditures.

Note the order of sequence. If one seeks an excess of returns over expenditures as the primary aim, the campaign may well fail to achieve its purpose. If one strives for advance, for improvement, for valuable result, for useful consequences, the financial profit will follow, unless the direction of the enterprise lacks acumen, sympathy, and knowledge. Hence the obvious need for a recognition of the broader interpretation of the word "profit," so as to be able to take advantage of the opportunities that exist for professional and business initiative.

How Many Engineers Could Answer Thus?

JOHN WELLINGTON FINCH, internationally known mining engineer-geologist, of Denver, and faculty member at the Colorado School of Mines, answered a question from the witness stand recently concerning his professional record in a manner that sets him apart from most of his professional brothers. Testifying for the government recently in its suit against officials of Canario Copper Company for using the mails to defraud, Mr. Finch was asked if he had ever reported adversely on a prospect that subsequently became a profitable mining property. His negative reply is a remarkable and unusual proof of his ability, particularly because of the conservative policies maintained by reputable examining engineers during the last score of years. Throughout this era, the rejection of all prospects examined, in case of any doubt, appears to have been the procedure generally followed, in order to avoid possibilities of endangering one's reputation. Certainly, few equally illustrious members of our profession could answer the question put to Mr. Finch as he did. Of course, many mining engineers of limited experience might make such a statement, for relatively few properties with indifferent outward prospects of success ever reach the stage of profitable producing mines.

Recent efforts of the government in bringing to justice such characters as George Graham Rice and the Canario Copper conspirators are most commendable. Its choice of Mr. Finch as expert witness in the Canario trial seemed propitious, and the federal counsel used Mr. Finch's competent advice and testimony to excellent advantage in establishing its case against the proponents of this recent drive on the pocketbooks of the credulous and uninformed investor.

A Warning to Mining Engineers

CONSULTING mining engineers should learn a lesson from the outcome of the Canario Copper case mentioned in the preceding editorial and reported in the news columns of this issue. Only a few months ago a New York jury convicted George Graham Rice and his associates for use of the mails with intent to defraud in the Idaho Copper case. In that trial, Rice's consulting mining engineer was let off with a warning, but there is no doubt that his professional reputation suffered considerably by his association. In the Canario case, just ended after a six weeks' trial, the mining engineer employed by the guilty company was not so fortunate and was convicted of conspiracy to defraud. In the present temper of the people as reflected by juries it is therefore evident that it is considered a crime to mislead investors by unduly optimistic statements about mining prospects of little value, and that all those associated with such deception are likely to suffer at the hands of the law.

Mining engineers must live up to high ethical standards if they value their professional reputations, much higher than do lawyers for instance. It is considered nothing reprehensible in the legal profession for a lawyer to try to keep a crook out of jail; some of the most highly regarded lawyers are continually using their skill to secure the miscarriage of justice. But a mining engineer will impair his reputation even by association with individuals and organizations of doubtful standing; and it is right that he should. If any members of the fraternity in future are tempted by a salary of anything up to a hundred thousand dollars a year from a company that bears the earmarks of a crooked promotion, let them remember that a jail sentence, a fine, and complete loss of professional reputation are likely to ensue, even though they may be able to retain their membership in the A.I.M.E. But more than all else they lose the social regard of their fellow men as friends and useful members of society, and when an engineer loses that, there is little more to live for.

Endless V-Belt Drive Finds Widening Use

INCREASING popularity of the flexible, short-center V-belt drive is evidenced by the fact that since a prominent manufacturer introduced it in the United States in the latter part of 1925, others have taken up the idea and introduced drives that are basically similar, though differing in details of construction. This system of power transmission employs endless V-shaped ropes or belts, made of rubber and fabric, operating without tension or slack on multiple V-grooved wheels.

Good reason exists for the popularity of this type of short-center drive. It has proved an excellent transmitter of power at close range, its efficiency having been shown on numerous tests to be 98 per cent or better. Consisting as it does of a number of narrow wedge-shaped belts, or ropes, each of which, instead of simply passing around the smooth cylindrical surface of a pulley, runs in a correspondingly wedge-shaped groove in the periphery of a wheel, this drive eliminates slip almost completely. Moreover, it permits the use of very short centers, requiring minimum floor space, and of larger speed ratios and higher-speed motors. It runs silently, an advantage at times, and without vibration, and, being flexible, readily absorbs shocks, thus protecting the driven machine against breakage. By reason of the multiple character of this type of drive, the breaking of one of the belts, or ropes, does not necessitate instant shutdown. The belts may be set at any angle to the horizontal, and may be operated without difficulty even when both driving and driven shafts are vertical. No belt dressing or lubrication of any kind is required, the drive thus being unusually clean.

Naturally, this type of drive has its limitations. According to Staniar, in "Mechanical Power Transmission," it should not be used in continuous operation where the atmospheric temperature is over 120 deg. F., or where adjustment to centers of at least 5 per cent of the center distance, to compensate for rope stretch, cannot be obtained; or on quarter-turn drives, or where the arc of contact of ropes on small sheaves is less than 120 deg. It should not be employed for speed ratios exceeding 7 to 1, or where excess mineral oil can come in contact with the belts. Moreover, it naturally cannot be employed unless the use of endless belting is feasible. In the aggregate, however, the advantages that have been cited more than offset these limitations and are sufficient to account for the favor with which the drive has been received.

Unemployment Statistics and the 1930 Census

THE REPORT on the causes of unemployment made recently by the Senate committee on education and labor, although reviewing much that has been considered at length previously by various agencies, presents among the seven recommendations enumerated one at least that appears to be particularly important at this time. This recommendation provides that in making the 1930 census the Bureau of the Census should ascertain how many persons were employed on a certain date and how many were not seeking employment although unemployed. Such action, in the opinion of the committee, should be the first step in developing an efficient system for obtaining unemployment statistics.

As was pointed out in the testimony taken during the hearings of the committee, no figures as to the number of persons unemployed in the United States at any definite time are available. Estimates based on the "shrinkage" of employment have been prepared, but these and other figures purporting to represent the number of unemployed have been nothing more than guesses. Besides the requisite of being accurate, such statistics to be of value must also be collected quickly, be comprehensive, and permit of correct appraisement.

It is proposed to develop employment statistics of this nature by measuring the shrinkage and the increase of employment and unemployment in a considerable number of industries and by applying to a norm previously established the factors thus obtained. Such an arrangement it is believed should permit a fairly accurate measurement of conditions to be made with sufficient rapidity

to meet any demand. The norm, of course, is nonexistant at present, and hence the recommendation of the committee that it be reached through information to be collected in the course of the 1930 census.

Owing to the present lack of adequate statistical employment data, and inasmuch as such knowledge is essential in considering any of the numerous problems of unemployment, this recommendation patently warrants inclusion in the plans for the 1930 census. Until detailed employment statistics are readily available from all sources involved—and it is unlikely that such data can be made available prior to the time that unemployment insurance is in effect throughout the country—establishment of the norm and the building up of the organization required to collect subsequently the supplementary necessary data appear to be logical procedure.

Petroleum Industry Seeking Way to Stop Excessive Production

CONFERENCES of petroleum producers, called for the avowed purpose of effecting a curtailment of production, can hardly fail to check to some extent the flood of oil from which the industry has long been suffering. The problem which they seek to solve is difficult. Any agreement to restrict the output of petroleum will subject the agreeing parties to the risk of indictment for violation of the law. Not that sentiment is not rapidly changing in favor of the producers. But the anti-trust laws are very definite and the opinion has been widely held—by Charles Evans Hughes among others—that such agreement would be contrary to their purpose. That the courts and the Federal Trade Commission will face about in their interpretation of these laws simply to oblige the oil men, or even because they may think public sentiment will support them in such a reversal of their stand, is too much to be expected. Legal procedure is orderly, if slow.

Liberalization of the law appears to be the proper road to the end desired, unless some genius can interpret the existing statutes anew convincingly in such a way as to sanctify an agreement to curtail. Perhaps assurance has been given that this is possible, inasmuch as producers have already agreed concertedly to decrease their output, according to widely published and seemingly uncontradicted reports. Mr. Mitchell, the new Attorney General, at Washington, has been asked by Secretary of the Interior Wilbur for an opinion of the plan adopted by the American Petroleum Institute, on March 28, to control the production of petroleum in the Western Hemisphere by holding the output in the current year to the level of 1928. Possibly he will be able to find the much desired happy interpretation.

Anticipating legal obstructions, the so-called committee of nine of the aforesaid Institute a year ago recommended legislation to permit agreements to curtail drilling and production "during a period of overproduction or in immediate anticipation of one," the proposed legislation further providing that the period of overproduction should be deemed to exist only when so declared by suitable governmental authority and to end when that fact should be similarly declared. Such legislation will doubtless be sought as soon as Congress convenes, unless some miraculous interpretation of the present law renders it unnecessary. Surely, relief is needed for oil men as much as for the farmers.

The favor of the public and of Congress should be courted in the meantime by the producers. Congress, of course, is likely to be swayed by popular opinion. The public's favor has already been won, no doubt, to a large extent. President Hoover's act in stopping further drilling on federal lands has impressed the people with the urgent need of lessening overproduction of petroleum. Moreover, although the public may profit for a while through the lowered cost of gasoline and fuel oil resulting from excessive output of crude oil at prices that are almost, if not actually, ruinous to the producer, nevertheless the vast body of individuals who either own petroleum shares or are dependent for their day-to-day support upon the petroleum industry, suffers, or will suffer, as a sure result of such excess production. Peter cannot be robbed to pay Paul without Paul also suffering if he has a material interest in Peter's welfare. For this reason, a large portion of the public must by this time be well aware that some means of curtailing the oil output must be found.

Words alone will not suffice to curtail the production of petroleum. However widespread the propaganda, or forceful the argument, only the loyalty of producers to each other in their common cause will bring about an effective cut in output, assuming that a legal means of doing this be found. Whether the producers themselves are capable of the sustained co-operative effort necessary remains for the future to disclose.

An Old Metal in New Form

A NEW METAL excites interest, but for one of the common non-ferrous metals to appear in a new rôle and to exhibit unusual properties is of still greater interest, although claims made for it by interested persons may be received with greater reserve until they have been fully tested and accepted in industry. The electrolytic zinc produced by the Tainton process at the new plant of the Sullivan Mining Company is characterized by an extremely high degree of purity—a month's run indicating a zinc content of about 99.995 per cent, compared with about 99.95 per cent in zinc heretofore commercially available. Naturally, an attempt is being made to capitalize on this fact by proving that the metal has superior qualities which would justify its preference over less pure grades, even to the extent of charging a somewhat higher price.

That four or five hundredths of a per cent of an impurity such as lead, iron, or cadmium would have much effect on the properties of zinc is hard to believe, but preliminary tests indicate that it does. Rolled into extremely thin sheets, for instance, the new product can be crumpled and bent without cracking, and it can be hammered to a thickness of one sixteen thousandth of an inch. It seems especially adaptable to being drawn into fine wire, and to extrusion processes. For die casting, it has been most successfully used as a component of the alloy known as No. 21, containing copper, aluminum, and magnesium, though here one would naturally think that the impurities introduced by the addition of other metals would make the high purity of the zinc used

of less significance. Preliminary tests of the tensile strength of this alloy, using the purest zinc, indicate it to be close to 50,000 pounds per square inch, with an elongation of two to five per cent, and an impact strength of one hundred and fifty foot-pounds.

Other producers of high-grade zinc will be keenly interested in the final results of the experimental work, so that they may determine whether or not it is desirable to produce a more highly refined product. For some purposes it is probable that the slight impurities present in ordinary high-grade zinc are advantageous.

The introduction of this pure zinc emphasizes how little we know concerning the properties of metals so pure that their impurities defy analysis. What superior qualities do such metals have and are they sufficient to justify their increased cost? For years, lead has been produced and sold commercially, of a comparable grade to that of this new zinc, its purity ranging from 99.992 to 99.995 per cent, but no important advantages in any wide field of use have been evident, probably because the effort has not been made to find them. Ordinary commercial copper is said to have a purity of about 99.95 per cent, the chief impurity being oxygen: what are the properties of 99.995 per cent copper, and would this metal be worth what it would cost to make? The alloy field affords infinite possibilities for experimentation with pure metals. In developing a process to give a zinc of such high purity, Mr. Tainton has challenged metallurgists to explore the field for the commercial application of this and similar metals.

Scope for the Upward Leaching of Suspended Matter

IN THE EARLY DAYS of the cyanide process, before the development of the vacuum filter, many technicians concentrated attention on the problem of treating the slime that was released or formed during the crushing of the ore. In those days we knew little about the influences responsible for the maintenance of fine particles in suspension in a stagnant or a moving liquid vehicle. The function of an electrolyte and the factors of electrical repulsion among such particles were not appreciated, and "colloid" was a little-used and less-understood term. Nevertheless, courage and inquisitiveness led to exhaustive experimentation; and logical deduction, which has stood the test of time, insisted that the opportunities for continuous upward percolation through a suspended mass of matter were of negligible importance. The acceptance of this verdict was hastened by the wide publicity given to all phases of cyaniding research and practice during that most interesting and intensive period in the development of hydrometallurgical technique.

In at least one other industry—concerned with the production of natural nitrate—the advantages of intellectual co-operation such as this have been ignored, and an acceptance of obsolete methods has gone hand in hand with conversational criticism of attempted technical reform. A few years ago a move was made to give scientific research a place in the industry commensurate with its opportunity for service in cheapening production and increasing efficiency. An organization was formed. However, instead of making a preliminary technical inventory of what had been done—covering the obvious defects of the older methods and segregating what was promising in more recent work—the officials plunged into invention. One result of this was that an early staff disintegration occurred, leaving control in the hands of a group the technical anchor of which was a dogged adherence to the Banthein process as the salvation of the industry. This process is based on the assumption that an ore if ground sufficiently finely can be treated by upward percolation, the insoluble particles being kept in their respective positions of stationary suspense—the technical and economical impracticability of which was protested at the time. Banthein enthusiasts, however, refused to be drawn into discussion. Vast sums have been spent in recent years, with no promise in sight of return to the investors; nor is there relief for an industry that is groggy with repeated announcements of fresh inventions.

In Europe, as we have pointed out before, a measure of success has been attained in the treatment of a potash mineral by the application of the Banthein process. In the natural nitrate industry, however, no opportunity for its utilization can be seen by disinterested technicians. The reasons may be reiterated, as follows:

1. The excessively fine grinding of raw material that does not need such reduction in order to expose the soluble to the action of a solvent would be clearly an avoidable expense and a complication.

2. If an attempt be made to percolate in an upward direction through a pulp of fine material in suspension, such material containing the customary constituents of an ore—as silica and colloidal clay, for example—the vessel in which the operation is performed must inevitably act as a classifier. If, by adjustment of flow rate, the particles of lower specific gravity are retained in stationary suspension, the particles of higher specific gravity will tend to settle. Or, conversely, if the particles of higher specific gravity, during the same period of control, are retained in stationary suspension, the particles of lower specific gravity will escape with the effluent.

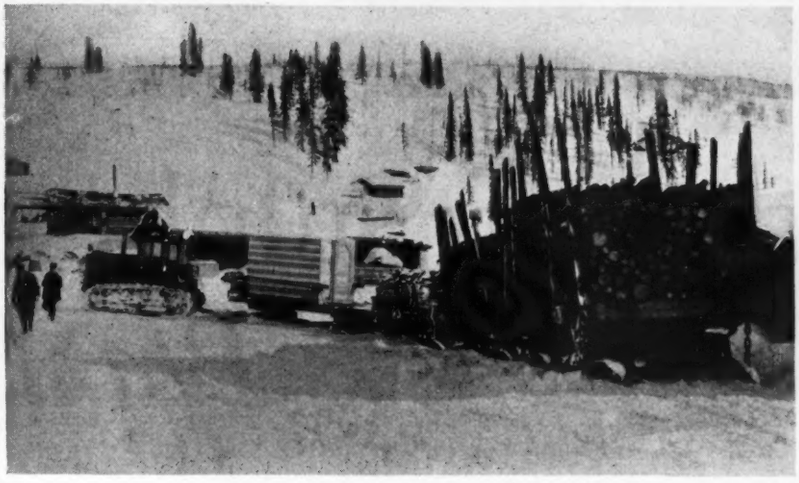
3. The entering lixiviating solution must be applied evenly over the lower part of the charge; with a fine material, the use of a bottom support of the usual character is impracticable. In an attempt to obviate the difficulties experienced in the application of the Banthein process to an ore of normal gangue characteristics, a perforated false bottom is used, beneath which the lixiviating solution is introduced. This permits even distribution, but it invites complication when upward lixiviation is concluded and when the charge must be drained prior to the discharge of the residue.

Adequate drainage is impossible under such conditions. Consumption of water will be excessive.

In the attempted application of the Banthein process in the treatment of ore, its sponsors have maintained that the escape of slime with the effluent is unimportant, and that contaminated leach liquor can be reintroduced under the charge, or the slime removed in settlers. This somewhat naïve explanation is merely an evasion of the fact that any method of recovering a soluble associated with an insoluble ceases to be a leaching process with economic and technical possibilities when part of the insoluble is removed with the lixiviant.

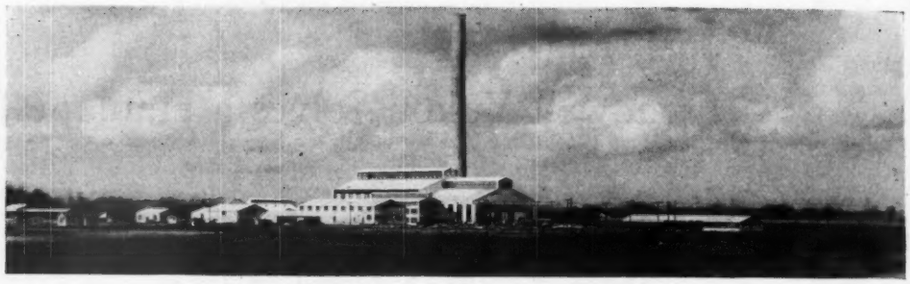
A frank discussion of this analysis of an interesting technical situation would be welcomed. It should either serve to disprove the results of experience and careful analysis, or help to prevent the continued waste of large sums of money in an attempt to achieve the impracticable.

Treadwell Yukon Solves a Haulage Problem



With temperatures down to 60 deg. below, and a 45-mile haul from mine to river navigation, the Treadwell Yukon Company has successfully solved its transportation problem from Keno Hill to the Stewart River by the use of caterpillar tractors. At the left is shown a ten-ton tractor hitched to a timber train, 30 to 40 cords constituting a load. The elevation is 4,500 ft. above sea level. Airplanes are also used to keep the Keno Hill camp in touch with civilization.

The three trailers in the photograph above carry 60 to 75 tons of silver ore and concentrate; several tanks are also visible on the last load. To the right is a pile of 7,000 tons that has been hauled across country and is awaiting shipment, when river navigation opens, to White Horse. Transportation costs by team from Keno Hill to Mayo were formerly $26.50 per ton, but were cut to $8.50 by the use of tractors. Operations were fully described in the Feb. 16 issue.



The power plant and shops at Newgulf

New Texas Gulf Sulphur *Plant*

Record Time Made in Bringing Project To Fruition

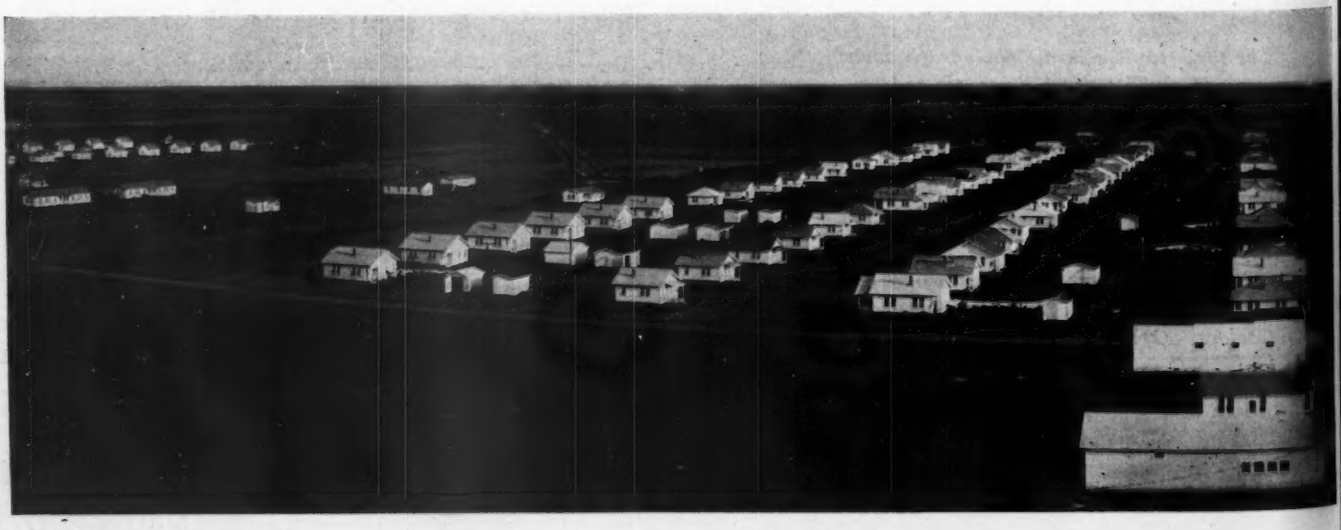
WITH the production of sulphur now under way at its new plant at Newgulf, Tex., on the Boling dome, the Texas Gulf Sulphur Company, already the world's largest producer of sulphur, is in a position to meet a greatly increased demand for that commodity in the future. Of the three great factors in world supply, which include the Texas Gulf Company, the Freeport Texas Company, and the Sicilian group of producers, known as the Consorzio, the first named is now easily the largest. Production of sulphur, by the well-known Frasch process, was begun at Newgulf in the latter part of March.

Aside from the economic possibilities inherent in the indicated expansion of this well-established enterprise, the new development is worthy of attention because of the remarkable rapidity with which the project has been brought to fruition. Operation of the new plant began almost exactly two years after the first disclosure, by drilling, of the possibility that sulphur might be developed in quantity. This was in March, 1927.

An intensive drilling campaign was then started for the purpose of proving up the deposit and ascertaining its limits. As soon as this drilling corroborated the evidence obtained in the first well that the deposit was indeed worthy of exploitation on a commercial scale, plans for the new plant, now completed, were started and construction work was begun. The power house, which is the most modern of its kind yet built, was erected by the J. G. White Engineering Company, of New York. In addition, a modern town of more than 300 dwellings, provided with all facilities, has been built south of the plant.

To carry such ambitious plans through to completion in so short a space of time is indeed a remarkable achievement. From the technical point of view it constitutes a record in bringing sulphur into quantity production in an entirely virgin field.

Newgulf, Texas—A modern town built by the



A near view of the attractive homes at Newgulf

Starts Operation

The town of Newgulf, at which the plant is situated, is almost 40 miles due north of the Texas Gulf Sulphur Company's property at Gulf, from which the company produces over 1,000,000 tons a year. Newgulf is about 60 miles due west of Galveston and approximately 50 miles southwest of Houston. Railroad facilities to handle the heavy traffic that will result from the large production of the recently erected sulphur plant have already been provided. The town is at present connected with the Southern Pacific Railway by a line across Caney Creek, and the Santa Fe Railroad is now engaged in building a connecting link.

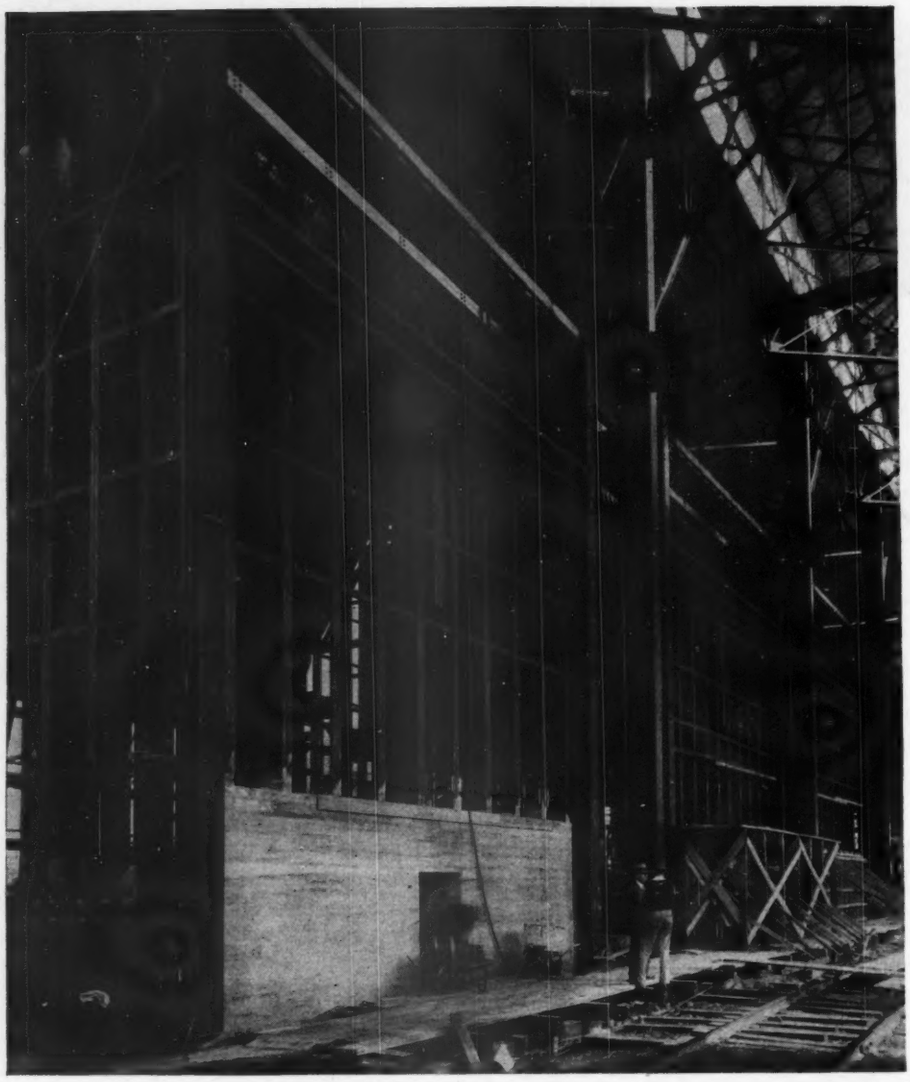
The exploratory drilling campaign has involved the sinking of about 250 wells, the depth of which varies from 500 to 2,000 ft. In this way the approximate edges of the deposit have been determined as closely as is possible, in view of the mode of occurrence of the sulphur, and a basis for calculating the probable tonnage has been obtained. Data thus collected indicate that the deposit contains several times as much sulphur as the deposit in the Big Hill dome at Gulf. The Boling dome in which the sulphur occurs is probably the largest salt dome ever found, being over 4 miles long in a north and south direction and about 3 miles wide, as determined by geophysical methods.

Details of the Frasch process, by which the sulphur is extracted from the ground and delivered on the surface, are too well known to warrant repetition here. An outstanding feature of the process is the quantity of water required for its operation, an amount that is huge in any case, though varying with the dome. The water supply for the Newgulf plant is obtained from the San Bernard River and from certain wells.

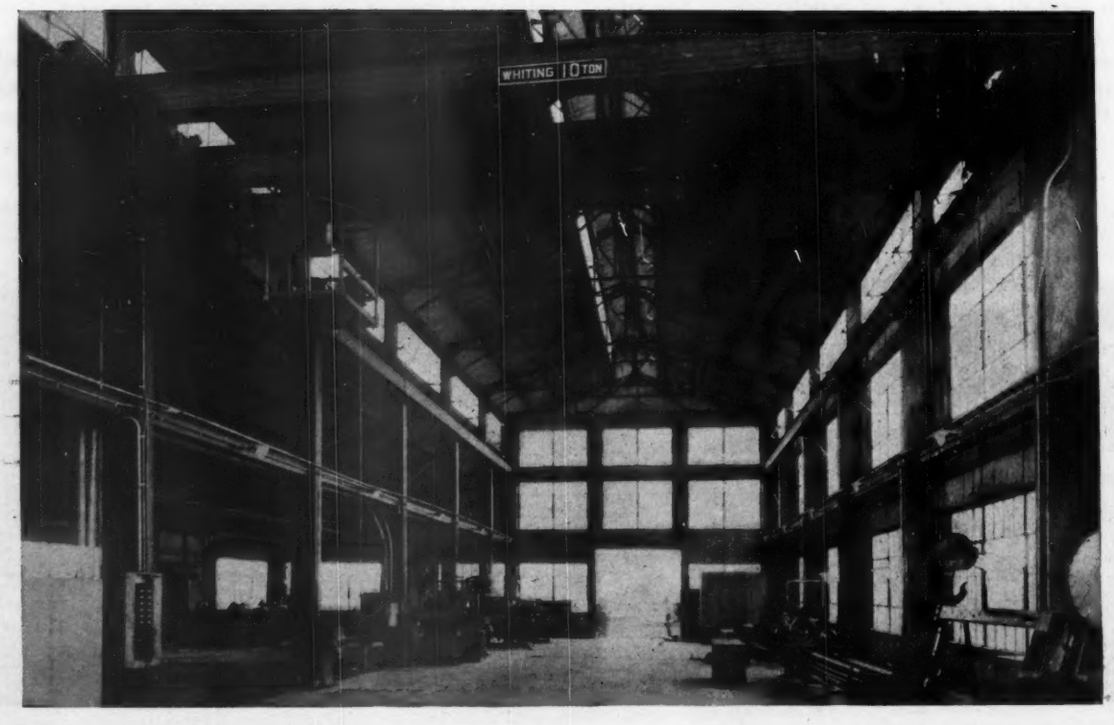
On the river bank a pumping station, having four units each of 10,000 g.p.m. capacity and capable of working against a 65-ft. head, has been erected The pumping capacity is actually much in excess of plant requirements, this purposely to enable the pumping station to take advantage of the seasonal variation in the supply of water. Ample facilities for storing water have been provided in the form of a reservoir of 262 acres extent and capable of holding 750,000,000 gal. Part of the water required for operation is converted into steam, which is then used to superheat the remaining water required for extraction of the sulphur and for supplying the steam lines used to keep the sulphur flowing from the wells in a molten state until it can be delivered to the vats for storage. Technical details of the process will be published, according to present plans, in a future article.

To generate the large amount of steam required to heat the water a power house containing five 1,500-hp. boilers of the water-tube type has been erected. In addi-

Texas Gulf Sulphur Company in record time



This view of the Texas Gulf Sulphur Company's new boiler plant at Newgulf was taken on Dec. 3, 1928. Today the plant is completed and in commission. Three of the five 1,500-hp. units are shown. Below is an interior view of the machine shop.



tion to the boilers, it is equipped with the necessary hot-water heaters, air compressors, pumps, and electric generators required for plant and townsite purposes. A plant capable of treating 280,000 gal. of water per hour, and designed for the treatment of both the boiler feed and the water for the mine, has been provided.

A problem that would speedily become serious, if neglected, is presented in the need for disposing of the water that sooner or later must be taken out of the ground. Obviously, huge quantities of water needed to melt the sulphur underground cannot be pumped for an indefinite time beneath the surface without eventually requiring some outlet. The removal of this water is known as "bleeding," and the so-called "bleed" water is taken from the edge of the operating area after it has given up the bulk of its heat. Naturally, while underground, it has taken impurities into solution, so that it is quite unsuitable for further use in the plant. Moreover, it cannot be discharged into the near-by fresh water streams, lest it contaminate them. To dispose of it, therefore, a ditch 20 miles in length has been constructed through which the water is discharged into tidewater. On being extracted from the ground, this "bleed" water, owing to its absorption of hydrogen sulphide, has an unpleasant odor, and to remove it the water is aërated before being discharged into the ditch.

For operation of the plant, natural gas is available in the district and is the fuel that will normally be used. However, to guard against the possibility of any temporary failure in the supply of natural gas, the boiler plant is equipped so that fuel oil may be burned if desired, the design being such that the feed may be switched from gas to oil or from oil to gas within a few minutes. In addition, the plant is so designed that, with slight adaptation, it can be operated on lignite fuel. To store the supply of fuel oil requisite for emergency operation a tank of 80,000-bbl. capacity, surrounded by a levee, has been provided, adjoining the plant site.

An interestingly large stack, shown in the accompanying illustrations, has been built to provide the boiler plant with the necessary draft. Its inside diameter, at the top, is 18 ft. It is built of brick and sets on a huge monolithic base of concrete, to construct which approximately 1,300 yd. of concrete and 60 tons of reinforcing rods were used.

Not the least interesting feature of the enterprise is the townsite. Construction of this proceeded simultaneously with that of the plant and with the development of the drilling program. The town is quite modern in all respects. Each of the more than 300 dwellings is provided with electric light, natural gas, and running water. Every house has ample ground, the lots, for the most part, being about 85 by 120 ft. in dimensions, this arrangement insuring an abundance of light and air. The architecture is varied, four standard designs being used, the fourth house in every row being of the same design. The houses have from three to six rooms each, each bedroom being really convertible into a sleeping porch through specially designing the outer wall between the windows, enabling it to be raised to permit the free circulation of the breeze in warm weather. The town is provided with a modern sewer system and has a number of stores to take care of the needs of the populace.

New Method Devised for Separating Tantalum and Columbium

DISCOVERY of a new method of separating tantalum and columbium has been announced by the U. S. Bureau of Mines as a result of an investigation conducted at the rare and precious metals experiment station of the Bureau in co-operation with the University of Nevada, at Reno, Nev.

Among the so-called rarer metals, columbium has as yet found little or no industrial application, although tantalum, with which it is practically always associated in nature, plays an important rôle in the manufacture of dental and surgical instruments, pens, crucibles, electrodes and electrolytic rectifiers. Tantalum alloys readily with many other metals, such as iron, aluminum, molybdenum, titanium, and tungsten. The importance of these alloys lies in their high melting point and great hardness.

Although the properties of columbium resemble closely those of tantalum, it has received comparatively little attention. A partial reason for this has been due to the difficulties involved in the methods available for the extraction of columbium.

The new separation process possesses an advantage both in time and expense over the older methods of obtaining columbium free from tantalum. Should this method prove satisfactory for the separation of large quantities of these elements, it should result not only in a cheaper production of tantalum but in the stimulation of interest in columbium, and should bring into use one more of the rarer metals whose properties have been so beneficial to the manufacturing industries.

Mining Pillars by Diamond-Drill Methods

REMOVING PILLARS in underground operations requires the development of well-planned extraction methods if satisfactory results are to be obtained. Such operations, moreover, generally involve the solution of a number of new problems, and a description of methods employed is consequently of particular interest. In a forthcoming issue the removal of vertical pillars at the Engels mine, of the Engels Copper Mining Company, will be discussed in an article by Mr. W. I. Nelson, superintendent of the property. A bench system of mining, in which machine drills were used, was adopted at the start, but this was superseded by diamond-drilling methods that reduced drilling and blasting time, as well as effecting a material saving in costs. Mr. Nelson's article will provide much information of value to those concerned in underground operations

What Will

ARTHUR B. PARSONS *examines some of the features*

FOR MANY YEARS the writer of this article has been a close student of the copper industry, formerly as associate editor of "Engineering and Mining Journal" and more recently as vice-president of the Mineral Research Corporation. His summing up of the then current situation in the Aug. 11, 1928, issue attracted wide attention; the present article, supplementing that, comes at a time when the attention given to copper prices is at its height, and that it is timely is evidenced by the fact that it was rushed into print the day after it was written. Mr. Parsons of course does not attempt to say exactly what the course of prices will be, but indicates that present levels are not likely long to be maintained and that, judging from the available data, the ultimate consumer seems assured of getting all the copper that he may require.

EARLY last August I wrote for the *E. & M. J.* an article captioned "Copper Outlook Brighter; Industry in Strongest Position Since the War." The concluding sentence was, "The stage seems set for an era of better times in copper." I ventured to predict a substantial increase in consumption and higher prices for the metal, with consequent prosperity for the producers. Other less optimistic "students" of the copper market suggested that I must have been wearing rose-colored glasses. Copper was then selling at 14¾c. delivered, and world's production and apparent consumption for the preceding five months had been at the average rate of 1,828,000 tons per year. As this is written the price is 24c. (by the time it is in print this price may be but a memory), and the average rate of production and apparent consumption for five months had been 2,135,000 tons, an increase of 16.8 per cent. Assuming that the average cost of production is 9c. per pound, the earnings

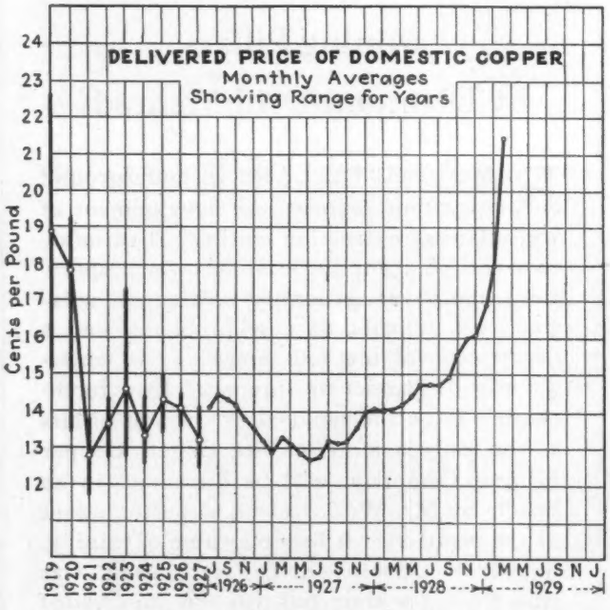


Fig. 1 — Trend of copper price in recent years

of the copper industry at the moment would then be at the rate of $640,000,000 per year, compared to $210,000,000 last August. I am fully aware of the fact that the companies have not sold, and are not likely for a long time to sell, a year's production at 24c., but the comparison serves to delineate the present position—a position which most will agree is abnormal.

When I wrote the bullish (as most called it) article in August I did not dream of a condition like that existing today; nor do I think that the most optimistic among the producers had any serious notion that copper would reach 24c., or for that matter 20c.; for the advance above 20c. is the result, more or less, of mere momentum.

The questions that many would like to have answered are these: (a) How long will copper stay at 24c. (or 26 or 27c.—wherever it may find a top); (b) how fast will it go down when it does start down; and (c) at approximately what price range ought it to reach reasonable stabilization over a period of several years? No one can supply the answers with any assurance—certainly I will not hazard any definite guesses. It is interesting, however, to enumerate and examine some of the factors that have a bearing on the subject. That I shall attempt to do, and the reader can make his own conjectures.

One must of course start with the fundamentals: (a) Consumption: What the needs of industry will be, and how these needs may be affected by price; (b) Production: What can be produced, and what will be produced under the stimulus of certain prices for the product; (c) Unit cost of production: The price of a commodity for which there are numerous substitutes, which is in universal use, and in the production of which there is no monopoly, is going to coincide roughly with the cost

Copper Do?

having a bearing on present and future prices

of production of the "marginal" supply—that is to say the most expensively produced metal that is needed to meet the demand. The smaller the proportion that high-cost production bears to the total, the less likely the price is to remain at high levels.

In addition to these three fundamental economic factors, there are four collateral factors that must be taken into account, both in explaining the recent behavior of the metal market and in analyzing the future. These are: (a) The market for shares in metal-mining companies. "As the metal goes, so go copper shares"; and as many important producers are interested to a more than incidental extent in the share market, this factor is important. (b) The Copper Institute, an organization through which comprehensive statistics of production, sales, selling prices, and consumption of copper are made available to producers and sellers of the metal. (c) The progress in the merging of producing companies and the vertical integration in the copper industry whereby activities in mining, smelting, refining, fabricating, manufacturing, and marketing come under a single control. (d) The "psychology" of buyers, taken collectively, that induces them to become panicky on a rapidly rising market and make purchases in large—even excessive—volume and for many months in advance.

Each of the foregoing factors either has had some influence on the phenomenal climb of the price of copper, or will have an influence on the descent that seems certain to eventuate. Naturally, the interplay between the various forces has been rather complex, but they will be considered in order as logically as possible.

Consumption—In considering this factor a distinction must be drawn between "apparent" and "actual" consumption. The American Bureau of Metal Statistics compiles monthly a reliable figure showing shipments of refined copper to domestic (U.S.A.) consumers. This gives a means of ascertaining apparent consumption in the United States. To get monthly data on world consumption the only practicable method is to adjust the figure representing production by the amount of change in stocks in the hands of producers. These include supplies at smelters and refineries in North and South America and at warehouses in Great Britain, Havre, and Japan. Stocks (see Figs. 3 and 4) have changed only a little since June, 1928, so that from a practical standpoint apparent consumption has synchronized with world production—which, as already pointed out, has been at a record-breaking rate during the last five months. The accompanying chart, Fig. 2, shows graphically domestic deliveries and world production by quarters. The plotting is on a logarithmic scale, so that a trend line that is straight represents a uniform acceleration in the rate of increase. The line *AB* indicates the trend of domestic consumption; the slope is such that the figure for each year is exactly 6 per cent higher than that for the preceding year. The portion *CD* of the line representing the trend of world production shows a less rapid acceleration, but it is assumed that by the middle of 1927 European economic conditions had been readjusted to such an extent that the trend line for the next few years might reasonably be projected on a slope showing 6 per cent annual increase. This line is *DE*.

The feature of the chart is the rather startling behavior of the broken lines showing the consumption in the last quarter of 1928 and the first quarter of 1929. The points representing the final quarter of 1928 were apparently abnormally high, but not to such an extent as to cause surprise. However, the fact that, instead of turning back toward the normal, the "curves" continued upward warrants some speculation as to possible explanations. There are two: (a) that, as a consequence of activity on the part of electrical manufacturing, automobile, and public utility companies, and in a dozen lesser industries, this vastly increased amount of copper has found its way into the possession of the ultimate consumer—into actual consumption; or (b) that somewhere between the copper refinery and this ultimate consumer a substantial accumulation of stocks has taken place. Producers insist that their immediate customers—the so-called fabricators—have not accumulated copper to any great extent; but it must be recalled that five or six months ago the policy of hand-to-mouth buying was be-

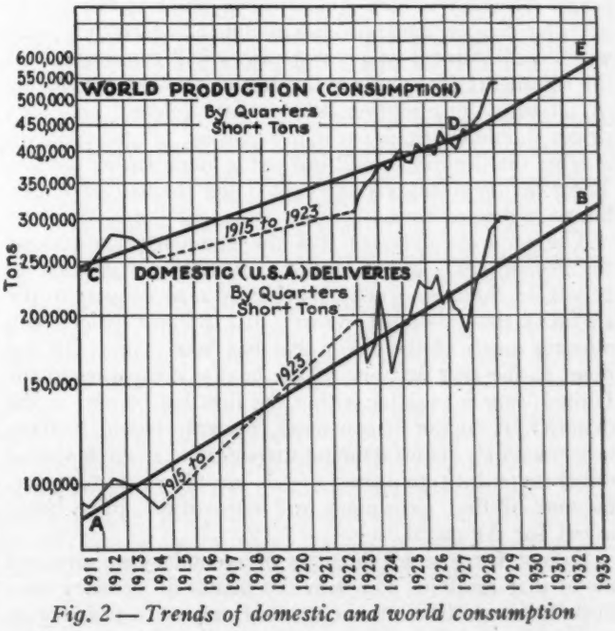


Fig. 2 — Trends of domestic and world consumption

ing followed to the utmost, and that even a modest realignment in this respect on the part of scores of fabricators would in the aggregate account for a good tonnage of copper. Further down the line are the manufacturers and even jobbers in whose hands a lot of "unconsumed" copper may have accumulated. Those who are inclined

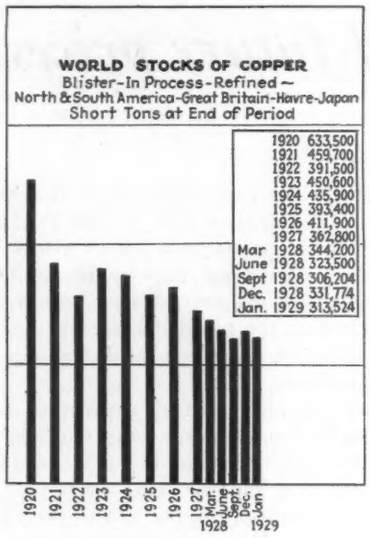


Fig. 3 — World stocks of copper in recent years

to think that the actual consumption is very much less than apparent consumption argue that with a commodity in such large, diversified and general use as copper, an increase in *actual* consumption of 20 per cent in a period of a few months is contrary to economic experience.

The importance of the answer to the question whether actual is much less than apparent consumption lies largely in its bearing on the approximate date at which the downward readjustment of present prices will commence. If the shipments from refinery reflect closely the actual rate of ultimate consumption, the present demand and high prices should continue for many months. If the contrary is true, the decline should start at a much earlier period. The reaction seems sure to come; the element of uncertainty is that of time.

The optimist declares that the cumulative results of the recent years spent in disseminating propaganda in behalf of the use of copper are only now coming to the surface; the pessimist retorts that present prices will alienate much of the favor that has been won. He can point to the fact that one of the largest companies in the United States, ranking within the first half dozen in the quantity of copper it consumes, recently issued instructions to all its manufacturing managers to make a special effort to substitute other metals or alloys for copper, because of the "exorbitant and unjustified" price being asked for the metal.

Except for a small quantity of secondary or salvaged metal that finds its way into the plants of primary producers, the statistics are concerned only with primary or newly mined copper. Under the stimulus of higher prices there undoubtedly has been marked expansion in the activities of collectors and smelters of secondary metal. No one is quicker to take advantage of a rapidly rising market than the "junk" dealer. He will hang on to his scrap copper till he thinks the peak price has been reached, then sell it to the smelter of secondary metal. The smelter, appreciating this condition, has sold casting copper for future delivery, but has hedged by buying electrolytic. As the scrap comes out the electrolytic is released, thereby suddenly adding several thousand tons to the market supply when it is believed that peak prices have been reached.

The situation resembles that which arose several years ago when lead was selling at from 9 to 10c. and a world shortage was predicted. With copper now, as with lead then, salvaging operations increased markedly, and they will tend to prevent the demand for virgin copper from increasing as rapidly as it otherwise would.

On the whole, therefore, it seems reasonable to project the lines of probable consumption through 1933 as shown on the charts. Certainly if the data available included only those through the third quarter of 1928, the forecast for future consumption would be no greater than that shown. The period since then has been abnormal for copper in several respects; and five months is too short a period to establish with any definiteness a radical change in the trend of consumption. The assumption that domestic consumption will continue to expand at the rate of 6 per cent cumulative per annum, and that commencing sometime in 1927 this rate became applicable to the entire world, appears to be justified. Whether this view is too conservative or not, only the future will reveal. On this basis the approximate figures of consumption may be read from the chart as shown in Table I.

Production—Heretofore the problem that has confronted producers has been this: How soon will world demand be such that productive operations can be conducted at the maximum of equipped capacity without resulting in a burdensome increase in stocks of metal in the hands of producers? In the article published in August, I attempted to estimate the equipped capacity of the important copper producers in the world. At that time I estimated that world production in existing plants could amount to 2,076,000 tons and that this could be realized without sacrificing efficiency of operation. As a

Table I—Estimated Consumption of Copper

Year	*Short Tons*
1929	1,900,000
1930	2,010,000
1931	2,130,000
1932	2,260,000
1933	2,400,000

Table II—Possible Production in 1929

	Short Tons		
Anaconda	150,000	Andes	100,000
Arizona Commercial	3,000	A. S. & R. (Mexico)	10,000
Calumet & Arizona	35,000	Boleo	12,000
Calumet & Hecla	72,000	Braden	100,000
Consolidated Coppermines	12,000	Bwana M'Kubwa	8,000
Copper Range	13,000	Cerro de Pasco	50,000
California Copper	6,000	Chile Copper	180,000
Ducktown (inc. Fontana)	6,000	Furukawa	18,000
East Butte	3,000	Granby Consolidated	30,000
Inspiration	55,000	Greene-Cananea	40,000
Kennecott (Alaska)	20,000	Howe Sound	25,000
Magma	20,000	International Nickel	30,000
Mason Valley	6,000	Mansfield	30,000
Miami	35,000	Matahambre	18,000
Mohawk	11,000	Mazapil	6,000
Mother Lode Coalition	10,000	Moctezuma	20,000
New Cornelia	45,000	Mt. Lyell	8,000
Nevada Consolidated	163,000	Naltagua	6,000
Old Dominion	10,000	Namaqua	3,000
Phelps Dodge (U. S. A.)	95,000	Noranda	35,000
Quincy	6,000	Poderosa	2,000
Shattuck Denn	3,000	Sumitomo	18,000
Seneca	2,000	Union Minière du Haut-Katanga	120,000
Tennessee Copper	6,000		
United Verde	85,000	Total foreign	869,000
United Verde Extension	25,000	U. S. and foreign	1,966,000
Utah-Apex	4,000	Unlisted	325,000
Utah Copper	190,000		
Walker	6,000	Total short tons	2,291,000
Total U. S.	1,097,000		

Table III—Distribution of 1929 Production According to Estimated Cost

Cost per Pound	Per Cent of Total	Cumulative Per Cen
7c. and under	26.0	26.0
7 to 9c.	24.0	50.0
9 to 11c.	36.0	86.0
Over 11c.	14.0	100.0

The 325,000 tons shown as unlisted (Table II) is included in "over 11c." distribution.

matter of fact the actual production, based on the performance of the last five months, has been at the rate of 2,135,000 tons per annum. If this rate can be maintained (and I am satisfied that it can), there is no need to fear any shortage of copper until 1931, even if the estimates of consumption shown in the foregoing table fall short of the real figures by 10 per cent in 1929 and 6 per cent in 1930. The accompanying table shows the principal producers of copper and an estimate of what each is prepared to produce in 1929, and what each will produce if nothing of an untoward nature in the metal market develops. See Table II.

If the economic incentive (in plain language, high metal prices) exists, producers of copper will find ways and means of meeting the demand. One company is mining and milling upward of 75,000 tons of ore daily, against about 40,000 a year ago. Others have increased output by from 10 to 40 per cent. Several measures are available: The plant capacity measured in copper can be increased by mining ore of somewhat higher average grade, or the through-put frequently can be increased by a small sacrifice in the fineness of grinding and the percentage of recovery in the concentrate.

Smelter capacity in the aggregate is substantially in excess of any likely production, because of the great increase that has taken place in the average grade of concentrates produced. In some quarters there is a tendency to question the adequacy of refining capacity. Within reasonable limits this can be expanded to meet all requirements. Several new electrolytic plants have been completed recently, and at least three others are in process of construction.

Much has been said of the tendency of higher prices for the metal to stimulate the opening of the small high-cost mines that cannot work profitably when lower prices prevail. This of course is a factor, but it is a small one compared with the increases in production that can be effected by the large established producers when and if they can see an outlet for the increased output. Because of the comparative simplicity of present-day concentrating plants, a large increase in capacity can be attained by the addition of a comparatively small amount of equipment.

Looking ahead to 1933 it appears that less than 125,000 tons in addition to the tonnage listed in Table II will be required. To provide this there will be available new production from Africa and Canada, which alone should easily provide the necessary metal.

Thus far no account has been taken of expansion in plant by the present important producers. Even if the estimate as to the rate of consumption is found to be, say, 10 or 15 per cent low, the fact will develop soon enough to permit the installation of such equipment as is needed to speed up production at producing properties. What the situation may be ten or even eight years hence is not so easy to foresee; but it is decidedly difficult to demonstrate that there is any likelihood of a famine for copper prior to 1935.

Unit Cost Production—No better proof of the abnormality of the present price of copper could be adduced than the fact that considerably more than 95 per cent of the current supply is produced at a cost, exclusive of depletion, of 14c. or under. It is highly improbable that one-half of 1 per cent of the total costs 17c. Theoretically, a situation such as this corrects itself automatically: the high price stimulates increased production, the supply outstrips demand, and the competition among sellers to dispose of their product forces the price to recede. As the price goes down those who are unable to produce at a profit normally stop producing. The

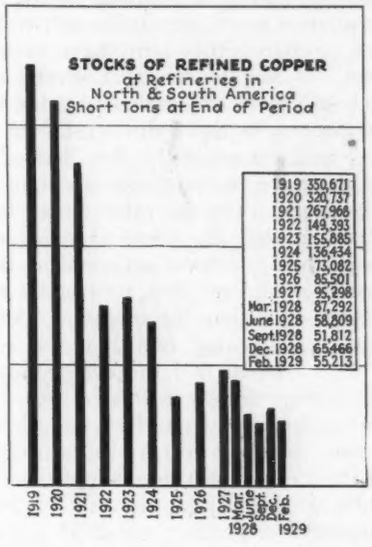


Fig. 4 — Refinery stocks show little decline in eight months

progressive withdrawal of high-cost producers as contributors to the supply causes an equilibrium to be reached between supply, demand, and price. A few producers who can just "break even" continue to turn out metal because it is expensive to shut down mines and they have hope that an increase in consumption and demand presently will raise the price so that they can again operate at a profit. In theory, it is the production cost of these so-called marginal producers that establishes the price. If, on the other hand, consumption has a decided upward trend, production may lag behind and the bidding of buyers against each other raises the price. As the price goes up, the progression is reversed, and more and more of the higher-cost producers become contributors to the supply. When enough of these have begun to operate, equilibrium is again established and the price is fixed approximately at their cost of production. Naturally, in practice this fundamental economic law does not operate with perfect precision and promptness. For example, if consumption (or apparent consumption) increases with great rapidity, and if for any reason production cannot be or is not increased rapidly, a situation may be created where for the time being sellers can obtain almost any price. That apparently is what has happened in the copper industry during the last few months. It seems safe to predict that in due time there will be a readjustment, and that a reasonable relationship between selling price and the production cost of a not inconsiderable "marginal" supply will be restored. At what price level this relationship will be established no one can say; but I will hazard the guess that it will be under 17c. How a readjustment can fail to take place,

unless some artificial obstruction is put in the way, is hard to see. Parenthetically, one may recall that it was not so long ago that certain important producers openly declared that the copper industry could thrive on a market ranging between 15 and 15½c.; they went so far as to say that higher prices would be unfortunate for the industry. As to this they may of course have changed their views.

This leads to a consideration of the four collateral factors that have been enumerated. To a remarkable extent prices for shares in copper-mining companies gyrate in synchronism with the price for the metal. If, for any reason, bankers or others who dominate the affairs of copper-mining companies desire to stimulate keen public interest in copper stocks and to increase the market price of shares, they must have favorable prices for the metal. It may be said that several of the large copper "interests" have had various definite and obvious reasons for desiring a sharp and sustained advance in share prices; and consequently they have looked with favor upon an active, upward movement in the market price for the metal. On the other hand, some of the producers, feeling that the eventual reaction would be harmful, looked with disfavor on some of the advances in price; but it is obvious that they could not in their own interest fail to follow the market. The only practicable means available for retarding the advance was to increase their output, and the evidence is clear that they have done their utmost in this respect.

The second factor, aside from those factors of consumption, production, and unit cost, is the information made available by the Copper Institute, supplementing Copper Exporters, Inc. Membership in this organization includes companies that produce about 95 per cent of the American production of copper—essentially the same group as compose Copper Exporters. The purpose as set forth broadly in the constitution is "to aid the copper industry through wider knowledge and clearer understanding of the economic factors affecting the production, manufacture; distribution, and consumption of copper and copper products." The principal activity thus far has been the collection, compilation, and distribution among its members (and, incidentally, *only* among its members) of very complete and informing statistics concerning production, prices, sales, and deliveries of copper. Presumably it is more than a coincidence that, following the launching of the Institute in November, 1927, a radical change took place in the policy of the important sellers. Whereas suspicion of each other, a habit of shading prices, and resort to seemingly futile competitive methods, had always been a characteristic of copper sellers, the year 1928 was marked by an era of sane marketing. On three occasions during the early part of 1928, periods of five or six successive weeks were allowed to elapse during which aggregate sales were meager in the extreme, but during which the large producers persistently held to a price until they were rewarded by huge buying waves. Prior to that time some seller under similar circumstances always had lost his nerve and had precipitated a general decline in the market by shading his price. As soon as weakness became apparent the buyers had the upper hand and took full advantage of it. Under the Institute régime each seller was given at frequent intervals an accurate statistical picture of the market position as a whole; he was able to gage the latent demand behind the market and thereby was enabled to shape his selling policy intelligently. In the same way the mining companies had complete information with which to guide their production policy. No collusion was necessary; but each group was enabled to act for its own best interest on the basis of the data supplied by the Institute.

No less apparent are the results of both horizontal and vertical integration of the industry. Gradually a considerable number of the smaller mining units have disappeared as separate entities, either through mergers or through the passing of control to one of the larger groups. This has tended to concentrate the formulation of broad policy—as of production, for example—into fewer hands and has thereby reduced the number of conflicts of interest, no doubt to the advantage of all. Also, the progress made by mining and smelting companies toward allying themselves, corporately or otherwise, with fabricating companies has had an influence (potential at least) on the behavior of the market. Normally the two "sides" of the copper market are the mining and smelting companies as producers and sellers, and the so-called fabricators as consumers and buyers. It is not difficult to see that if a substantial element of the buying group is absorbed by the selling group, the tendency is to weaken the forces that make for a sharp definition of the market price. In a tight market the existence of "buyers" who are not interested in keeping down the price may easily help the market up.

The last of the collateral factors is the "psychology" that induces buyers to rush into a rapidly rising market. This applies to buyers all the way down the line to the jobber of copper or brass products. It applies to European consumers as much as or more than to those in the United States. When the price of a commodity has shown a substantial advance, and when the air is full of propaganda that much higher prices are likely, it is human nature and good business perhaps to anticipate the further advance by purchasing somewhat more than enough to meet current needs. When the financial papers have repeatedly broadcast prophesies of advance, and when these prophesies have been fulfilled according to schedule, the buyer naturally believes in the accuracy of further forecasts. The producers declare—and in the case of many they are probably correct—that their immediate customers have taken only current needs, but the customer's customers and buyers still further removed from the producer have probably accumulated stocks of metal. It is on the assumption that they have that the hypothesis is based that apparent consumption has exceeded actual consumption by an appreciable margin.

It is maintained frequently—and stoutly—that since the 18c. level was passed the producers have been helpless and that consumers ran the price up by their insistence in buying. Some producers, I am sure, would have liked to see the price kept down; others perhaps were glad to see it soar and will be still more glad if it soars higher. But in any event the persistent demand on the rising market helped the price up.

From a purely economic point of view, the one uncertain factor in the situation is this: Has actual consumption—huge though it is—been substantially less than apparent consumption? If the phenomenal increase in shipments reflects a corresponding increase in ultimate consumption, and if the rate of increase is sustained, the market may remain in the producers' hands for many months, and they will be able to obtain fancy prices (anyone will agree that a price above 20c. is fancy) for a considerable period. But if any producer today looks for 20c. copper a year hence, he is not bold enough to say so.

If, on the other hand, actual consumption is much

less than apparent, there should be a very substantial increase in stocks in the hands of producers, to be revealed in the statistics in the third quarter of 1929; and that will alter the entire outlook. It must be remembered that producers already are well sold for July, so that there will be no strong compulsion to cut prices for several months. When the decline does begin, it may be drastic and rapid or it may be slow and orderly. This much may be said: That the character of the "retreat" will depend entirely upon the action of the producers. Through the data obtained from the Institute they will be able to foresee any marked divergence between the rate of production and the probable demand. If, as a group, they exercise even a small part of the common sense, patience, and restraint that they displayed during the year 1928, it should be possible to stabilize the market in a comparatively narrow price range that should be satisfactory to producer and consumer alike. To close this article with a note of optimism:

Whatever develops during the next nine months, the records will show 1929 to have been a banner year for the copper-mining industry.

Ceramic Substitutes for Chromium Are Needed

POTENTIAL USES of chromium metal open a field so useful to humanity that attention is called to the relatively large consumption of chromite as a refractory, in a report issued by the U. S. Bureau of Mines. In this use the service rendered is of but short duration. As chromium may be used for the preservation of many metals, it becomes evident that any of the uses which rapidly dissipate chromium should be eliminated. The desired end can be accomplished only by research work for the purpose of finding a substitute for the dissipating uses.

A refractory suitable to the requirements must have, among other things, the following physical and chemical properties: (1) Resistance to chemical reaction with fused metals, slags, and vapors; (2) resistance to deformation caused by a wide range of temperatures; (3) strength to withstand loads, blows, and shocks, in wide range of temperatures; (4) thermal conductivity; (5) durability (time of service); (6) uniformity; (7) resistance to erosion and spalling; (8) capability of conforming to accurate measure when molded.

The usableness of chromite as a refractory depends in part upon the physical structure. However, the most important requirement is the ratio of the chromium and alumina content to that of iron and silica. The demand of the paper-pulp mills for chromite brick has lately developed a seemingly expanding market. These brick fulfill a need in the lining of the kilns used for the drying of pulp in the sulphite process, as they resist corrosion caused by the liberated gases in the kiln.

Applying the Centrifuge to Concentration

THAT a properly designed centrifuge can concentrate and recover mineral particles which are too small to be saved by the usual gravity concentrators is indicated as the result of experimental work performed at the Rare and Precious Metals Experiment Station of the U. S. Bureau of Mines, Reno, Nev., in co-operation with the University of Nevada. A technical paper to be published will consist of a review of previous efforts to develop centrifugal concentrators, an exposition of the theoretical aspects of the subject, and a detailed description of the construction and operation of several new types of centrifugal concentrators. Experimental results include those obtained with small laboratory models and also with a machine of semi-commercial size operating under both laboratory and plant conditions.

The centrifuge makes available for concentration a force several hundred times as powerful as gravity. If a high centrifugal force is substituted for gravity in any type of concentrator, the velocity at which settling, and therefore concentration, take place is greatly increased. The increased force not only speeds up the settling rate of all particles suspended in the concentrating medium, but for the fine sizes the increase is greater for particles of high, than for those of low, specific gravity. This change in the relative settling rates of small particles of different densities is an important aid to concentration.

In crushing ores as a preliminary to concentration, a portion of the valuable minerals is inevitably reduced to very small particles, having such a low settling rate in water that concentration in gravity machines is difficult and often impracticable. This material can be successfully handled in a centrifugal concentrator.

Aërial Photographic Surveys Made in Southeastern Alaska

MAKING MAPS from photographs is not new, but the increasing use of the airplane has made it possible to get pictures of large tracts of country. Various departments of the government, as well as private concerns, have utilized this new means. The progress of aërial photographic mapping made it evident to the U. S. Geological Survey that this method would be particularly advantageous in southeastern Alaska, a region of strong relief and difficult to map economically by ordinary methods. As the Geological Survey had no facilities for doing the flying, it entered into an arrangement whereby the Bureau of Aëronautics of the Navy Department was to do the flying and take the pictures. The Alaskan Aërial Survey Expedition was organized by the Navy Department, and in 1926 successfully photographed about 10,000 square miles in southeastern Alaska.

An account of this project and of the methods by which the photographs are being used in map making is given in a report recently issued by the Geological Survey as Bulletin 797-E, by R. H. Sargent and F. H. Moffit, entitled "Aërial Photographic Surveys in Southeastern Alaska." A copy of this bulletin, as long as it is available, may be obtained by addressing the Director, U. S. Geological Survey, Washington, D. C. The bulletin is accompanied by a map showing the lines of flight and the numbers of the different photographs taken on each flight. It also contains a map of part of the Ketchikan-Hyder region, which was prepared from these airplane pictures, and which covers all of Revillagigedo, Annette, Gravina, and Duke Islands and parts of the near-by mainland and Prince of Wales Island. It is on a scale of about 4 miles to the inch. Relief is not shown, but all the streams, lakes, and other water areas are represented. It is the purpose of the Geological Survey to complete the topographic mapping of the area covered by this map as rapidly as practicable, and during the field season of 1928 a topographer mapped about 1,000 square miles in this area.

Tunneling Under the East River, New York

DRIVING the Fulton-Cranberry tunnels for the subway system under the East River between New York City and Brooklyn is a gigantic undertaking, as these will be one of the longest and most difficult to build of any tunnels so far constructed under water. The project was started in 1927, and has been under the direction of the Mason & Hanger Company, Incorporated, a New York firm.

Two concrete shafts have been built, one in Manhattan at Front St., and another at Fulton St., Brooklyn. These were landed almost in their exact locations without any delays or mishaps. The caissons were sunk under compressed air at the rate of about 3 ft. per day. One of the power plants for compressed-air tunneling is located in Burling Slip, New York, and the other near the Brooklyn Bridge in Brooklyn. These two plants have similar machinery. Each of the five low-pressure air compressors in each plant has a capacity of 5,600 cu.ft. of free air per minute.

The machinery for furnishing water under high pressure for the shield jacks and erectors in the headings consists of three four-plunger horizontal pumps having a capacity of 24 g.p.m. at 6,000-lb. pressure; also, an 8x42-in. hydro-pneumatic accumulator. There are eight tunnel shields having three pockets above and below the springing-line platform. Each shield has eighteen 10-in. jacks, making the total maximum shoving force of the shield 4,200 tons.

Details of the Work

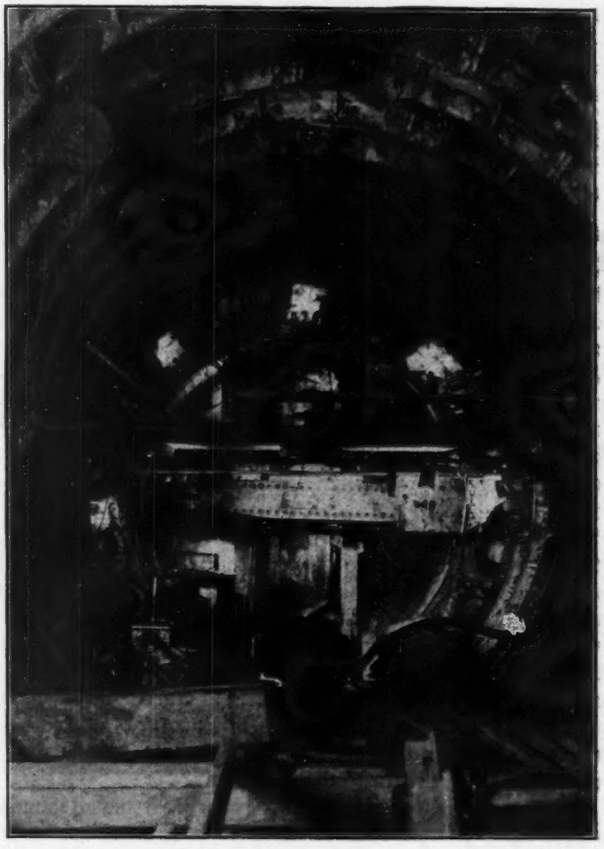
In operations of this kind it is the early part of the work—starting the shields from the shafts—that frequently requires more watching than the work which comes after the locks are ready. When the caisson is completed, the next job is to lower the timber cradle to the bottom in order to support the shield during its erection and to carry it as it is shoved out of the caisson into the ground. Upon the completion of each shield, the caisson deck is replaced in the upper position over the shield. In this work there is being used a mattson lock for removal of muck, a tee-head lock for the men, a segment lock for tunnel plates, and a timber lock for long timbers and pipe. The steel bulkhead in the wall of the caisson is burned out, after which the shoving operation is begun.

The muck is loaded into a caisson bucket and carried on a flat car from the heading to the lock. When tunnel work has progressed enough so there is room to construct the tunnel bulkhead with horizontal locks, the advance of the shield is stopped and the face is closed by a bulkhead in the forward part of the shield, thus permitting the removal of compressed air from the heading. The annular space between the outside of the cast-iron lining and the inside of the drum opening in the caisson wall must also be closed with concrete finished with a specially made steel connecting ring.

The bulkhead was made of heavy timbers behind a mass of salt hay. About 35 tons of this hay was packed between the face and the timbers of the bulkhead, and the shield was then shoved ahead, thus compressing the hay into a dense mat in front of the timbers. This design worked perfectly in the south land heading in Manhattan, but did not work out in the north river heading in Brooklyn. The coarse sand yielded a large flow of water that passed through the hay and timbers. Though no ground was lost, the amount of water which came through was too great to pump. Concrete bulkheads were then constructed to obviate the difficulty and these have worked successfully.

The concrete in the tunnel bulkheads is 6 ft. thick in the land headings and 8 ft. thick in the river headings. Each bulkhead has an emergency lock, a man lock, and a muck lock. The four land headings are being advanced under air pressure of from 13 to 16 lb.

Another obstacle which the contractors encountered, especially in the Burling Slip power house, was to get clean air for the compressors. The traffic in that section of the city is unusually heavy and creates a great deal of dust. In addition, within a few hundred feet of this power house there are six big stacks of a power house which emit a vast quantity of cinders and dirt. There was serious danger of this grit putting the compressors out of commission by scoring the reciprocating parts and by causing carbon, and should these compressors suddenly fail and shut off the supply of compressed air, not only would there ensue a serious delay in the work, but there would also be danger of drowning more than one thousand men who are working in these tunnels. The Staynew Filter Corporation, of Rochester, N. Y., was consulted, and after an inspection by its technicians that company installed nine large air filters, which overcame the difficulty.



Tunneling where a real water problem is presented

USEFUL OPERATING IDEAS

Building a Concrete Water Door Underground

By C. J. Rofelty
Old Dominion Company

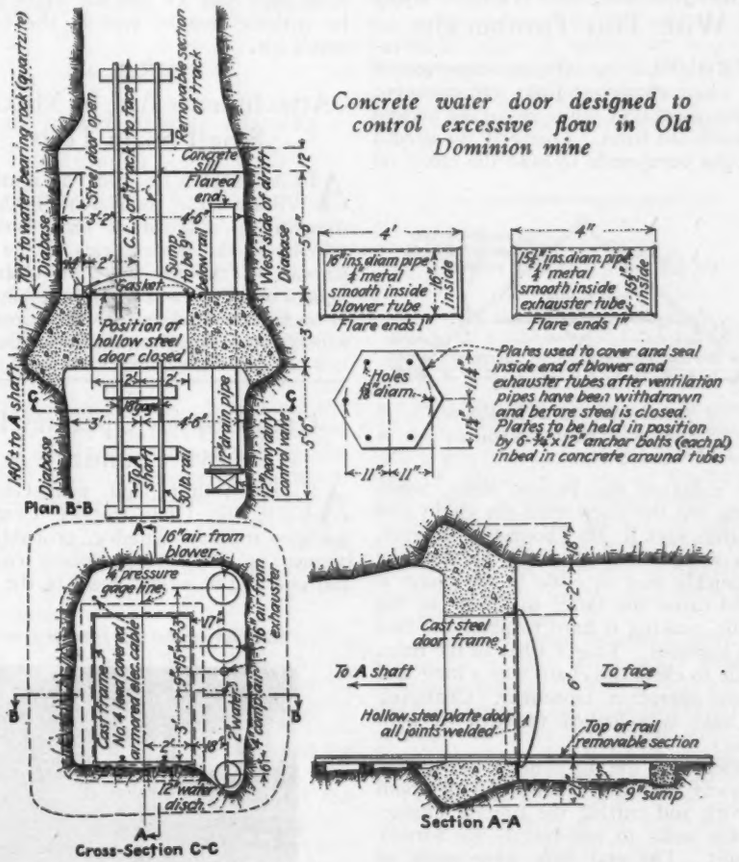
IN THE Old Dominion mine, at Globe, Ariz., the major development program of the 2,600 level, south from the "A" shaft, was slowed down by reason of extremely bad working conditions caused by excessive underground water flow. In the 26111 south drift progress was made for about 210 ft. from the shaft through dry diabase. At this point water-bearing quartzite was entered, and as development proceeded water up to 2,000,000 gal. per 24 hours was encountered. This being the pumping limit of the staging unit on the 2,200 level, provision of a means of absolute control of water developed was necessary to prevent the possible loss of the level and equipment by flooding. To this end the concrete door described in the following was installed.

The site selected was in diabase and about 140 ft. from the "A" shaft. After the side walls, back, and bottom of drift had been channeled about 18 in. deep and for a width of about 4 ft., concrete forms were erected, the cast-steel door frame was hung in place and anchored, and reinforcing steel was placed in position. The concrete plug is 3 ft. in thickness and has an opening 4 ft. wide and 6 ft. high, through which tramming may be done up to the time of closing the steel door which is also a part of the equipment.

Concrete was delivered wet-mixed from the central mixing plant on the surface and taken in mine cars to the site. A mixture of 1 part cement to 6 parts sand and gravel was used. Great care was taken to place and puddle the concrete carefully to secure as watertight a texture as possible. After the forms had been removed the entire surface was gunited with three coats and all holes, voids, and corners were thoroughly filled. The steel door was then hung, and control valves on pipe lines through the concrete were put in place. Provision was made for one 12-in. drainage line equipped with a heavy-duty control valve on the station side, this to control the underground water situation in case the door was closed. Provision was also made for a 2-in. service water line, a 4-in. compressed-air service line, one 16-in. ventilation blowing line, one 16-in. ventilation exhaust line, one No. 4 lead-covered armored submarine electric service cable, and one ¼-in. pressure gage line. The door and the reinforced concrete plug were designed to resist a hydrostatic water pressure of 78 lb. per square inch.

The rock, water, and air temperature in this drift is 109 deg. F. and the air has 100 per cent saturation.

Soundings are made at regular time intervals in a churn-drill hole driven from the 2,200 level to a depth of 680 ft. through the quartzite water-bearing zone. Soundings show a decrease of about 3 ft. hydrostatic head every seven days. The churn-drill hole is in direct line with and about 380 ft. south of the present face of the 26111 south drift.


Steel door open
Removable section of track
Concrete sill
Flared end
West side of drift
Diabase
Gasket
Position of hollow steel door closed
Plan B-B
16" air from blower
¼" pressure gage line
Cast frame
No. 4 lead covered armored elec. cable
2 water
12" water ditch
Cross-Section C-C
Cast steel door frame
To A shaft
To face
Hollow steel plate door all joints welded
Top of rail removable section
9" sump
Section A-A
Holes 1⅛" diam.
Plates used to cover and seal inside end of blower and exhauster tubes after ventilation pipes have been withdrawn and before steel is closed. Plates to be held in position by 6-¾"x12" anchor bolts (each pl) inbed in concrete around tubes
Flare ends 1"

Concrete water door designed to control excessive flow in Old Dominion mine

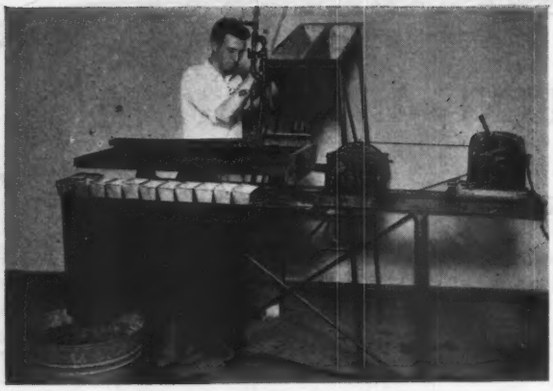
Insulated Mine Car Couplings Recommended

TRANSPORTATION of explosives in mines is extremely hazardous, and where electric haulage is employed the danger is intensified. Insulated mine-car couplings have been adopted by at least five companies in Alabama and Pennsylvania, and undoubtedly in other states, to prevent an electric current passing from the locomotive to a car or between cars joined by this coupling. The need for such protection is well recognized. When used on man-trips the insulated coupling further serves the purpose of guarding the men against shock.

General principles of construction are similar in all insulated couplings. The piece containing the hole for the coupling pin is made of steel and the steel parts are separated by an insulating material, such as fiber or wood. The coupling is either rigid or semi-rigid to prevent the bumpers of the cars from coming in contact and to keep the cars insulated from one another at all times.

A bad bond or the use of too much motor sand occasionally causes a poor ground and charges the locomotive frame. An electric current may then pass through the couplings and drawbars. If explosive is in an uninsulated car, the current may cause it to detonate. If men are riding in the cars, they may be severely shocked. Details of construction of four insulated couplings are given in Bureau of Mines Reports of Investigations No. 2868, by the authors F. E. Cash and C. W. Owings.

The Bureau of Mines recommends

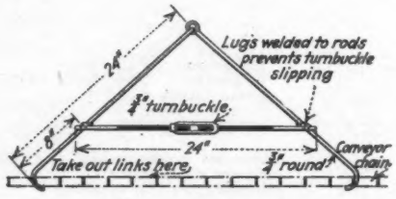


This miniature Wilfley table has convenient attachments

that explosives be transported in a specially constructed car or box. The insulated coupling should not supplant the insulated car, but may be used as an added means of reducing transportation hazards.

Conveyor Chain Repairs Easy With This Turnbuckle

TROUBLE is always experienced when changing links on conveyor chains, especially while replacing broken or worn-out links. Formerly we used a straight turnbuckle to hold the chain on



A turnbuckle that facilitates conveyor chain repairs.

both sides of the broken links, while taking out the slack until the chain was repaired, says R. M. Thomas, of Denver. This was difficult at times because the turnbuckle was so close to the chain it would cause the latter to buckle in the middle, making it hard to place the two ends together. To get a bar in the turnbuckle to clear the chain was a long and tedious operation, moreover. Changing the links was looked forward to with dread.

Design of the turnbuckle illustrated did away with this trouble, giving room to work and cutting the time of changing the links to one-fourth the former amount. The end rods were made of ¾-in. round steel, one end being turned to fit the conveyor chain, the others being linked together, making an eye joint.

Eight inches from the conveyor end a lug or collar was placed on the end rods, welding them in place. This was to prevent the turnbuckle sliding on the rods away from the chain. The end of the turnbuckle was made to fit around the ¾-in. rods, sliding on from the conveyor end until they rested against the collars. If more slack than the turnbuckle can make when all the way up is to be taken out of the chain, the links should be held in this position with a wire or chain, the turnbuckle taken off, and another hold obtained on some of the other links when the turnbuckle is screwed out to the end.

This turnbuckle was used for 4-in. links 1⅛-in. thick, but can be applied to smaller or larger chains as well. It is so much superior to anything else we have used that we feel we ought not to be without one or two in the repairman's kit.

Attachments Aid in Making Small Scale Tests

ATTACHMENTS for a miniature Wilfley table, as shown in the accompanying illustration, have been developed in the laboratories of the U.S. Bureau of Mines and the Missouri School of Mines and Metallurgy in their co-operative studies of ore dressing, which, according to Will H. Coghill, superintendent of the Bureau station, have proved very helpful to them in their work.

The hopper-like spout below the table, as shown in the illustration, is used during the adjusting period. It catches the discharge from the table, so that the discharge is thoroughly mixed for re-tabling. This scheme is necessary when the adjustments of the table are tedious or the ore sample is small. The feed hopper shown above the table is double, so that one hopper may be filled with returns from the "spout" while the other is being emptied to feed the table.

The small pans are arranged on a tray and handled as a unit. When the table and feed have been adjusted satisfactorily, the tray is then placed in the position shown to catch simultaneous cuts, or time samples. Ten four-inch cuts may be obtained, seven on the side and three on the end.

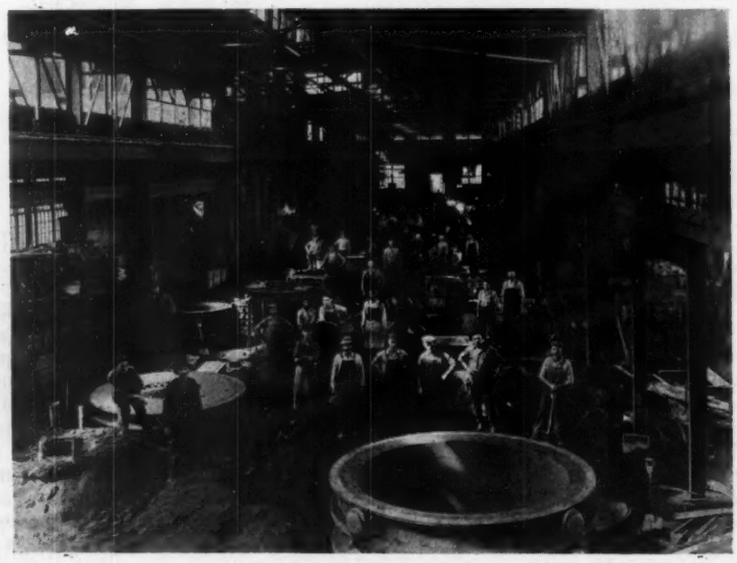
Old Files Make Good Tools for Wood Turning

Good wood-turning lathe tools, such as diamond points, square points, and the like, can be made from old mill files, writes R. M. Thomas, of Denver. The files should be ground on the emery wheel to remove all marks at the cutting end. This will not only make the tools cut better but will also prevent them from breaking. Ten-inch files are the best for the purpose. The temper of the files will be found correct for wood turning. In grinding them care should be taken not to burn them.

Utah Copper Operates Its Own Foundry

AT ITS Arthur plant, near Garfield, Utah, the Utah Copper Company operates its own foundry, probably the largest in the intermountain country and one of the largest west of the Mississippi river. Eighty-five men are employed. Recently, the foundry has been pouring 900 tons of castings a month. Maximum capacity is 1,350 tons monthly. The foundry has been particularly successful in manufacturing 2-in. balls for the company's tube mills. An interior view is shown herewith.

Interior view of foundry at Utah Copper Company's Arthur plant



COMMENT AND CRITICISM

Pyrites Prospects in Western Massachusetts

To the Editor of "E.&M.J.":

I have read with some interest the report in the March 9 copy of *E.&M.J.* regarding the decreased production of sulphur and pyrites in the United States; also noted the fact of the large increase in importations of pyrites (83 per cent increase in tonnage for 1928, the largest record since 1919).

This article recalls to me the possibilities of finding fair-sized bodies of pyrites ore in Massachusetts. One place is at Rowe, Mass., where the old Davis mine was run for many years very successfully by the late C. B. Stranahan. This body of pyrites was of a chimney type, and after this chimney was worked out to a profitable depth, and caving prevented further working, it was abandoned. Much trenching was carried on in hope of finding another body, but without success, but at this time the modern methods of locating metallic orebodies were unknown. Now, the likelihood of locating other chimneys is very probable by electrical prospecting. The agencies that cause one ore chimney may well cause others in the same district, so I am of the opinion that this region is merely scratched and will produce many thousand tons more of pyrites if modern methods of prospecting are used to find orebodies.

Users of pyrites at the Eastern seaboard would do well to make a memorandum of the fact set forth in the foregoing, because the time may come when the Spanish supply may be cut off and a new Eastern supply would be desirable.

I have also done some surface prospecting for pyrites in Warwick, Mass., in years gone by, by the trenching method, and I feel that here also is a possible reserve supply that might be located by electric prospecting. Although these districts may not seem important now, a war emergency would make them so. A survey of the Rowe district should be made to find other blowout chimneys of pyrite ore, as this district was a large producer for many years from only one chimney, the Davis mine.

It may be years before any company may be able to see a profit or have the courage to tackle these districts. They are, nevertheless, a possible emergency reserve that is well to pigeonhole among the possible Eastern sources of pyrites.

The Warwick, Mass., pyrites prospects are about 2 miles west of Iron Ore Hill in Warwick. Iron Ore Hill is a high, broad hill that has a small iron ore blowout showing, and, also, the ledges near by show the flowage of the rock when it was in a molten state, as perhaps no other rock in Massachusetts does.

About 4 miles directly south of Iron Ore Hill a copper showing is to be noted at the foot of Fall Hill, near Fall Hill Meadow. Most copper mines in the East have thus far been fizzles, but modern methods, and the exhaustion of Western mines, may make them profitable in years to come.

In my opinion, Iron Ore Hill may amount to something more than is indicated by its small showing of iron ore. The old German saying, "Iron rides a golden horse," may mean something here.

To explore small swamps and bog holes, which may have once been explosion vents, has been impracticable in the past, but by modern means of electrical prospecting one might find ore chimneys in some of them. In districts where an ore chimney has been a producer, every hill-locked swamp or bog near or about the top of the hill ranges should be carefully prospected by modern methods.

H. N. KIRK.

Keene, N. H.

California Placer Miners Victims of Lobbyists

To the Editor of "E.&M.J.":

The article in *E.&M.J.* of June 9, 1928, by Mr. James D. Stewart tells the truth, and there is much more to be told. It was not the owners of the alternate sections of so-called agricultural land who were losing their agricultural claims on placer gold-bearing land, and not the fruit lands of Marysville that were being washed out. It was not the laws, not the courts, but the snare statutes of California and the vicious lobbyists whose interests in transcontinental transportation caused them to prefer to ship in food supplies rather than allow local producers to sell to the miners—who coaxed and inveigled the farmers into voting for the Débris Commission.

Referring to your editorial, page 386, *E.&M.J.*, March 9, 1929: Boulders and flat rocks will not reach the lowlands, as they are difficult to move in a sluice at a grade of 660 ft. per mile. The lowlands and swamps will be benefited by the fine sand and silt.

Let the people, the miners and the farmers meet and adjust their own problems, and eliminate the selfish interests of the conniving politician and habitual office seeker.

HENRY WORTH.

San Quentin, Calif.

Geophysical Work in Locating or Patenting Claims

To the Editor of "E.&M.J.":

I read with interest your editorial in the issue of March 16 entitled, "Geophysical Work in Relation to Locating and Patenting Claims." I agree with your contention that if geophysical prospecting were to be considered under present conditions, considerable confusion and misunderstanding would result from the claims for "doodle-bug" expenditure allowances that would be forthcoming. I feel that the present ruling which makes it necessary for allowable work to show tangible results is best.

ED. S. GILES.

Goldfield, Nev.

Borderland Material Again

To the Editor of "E.&M.J.":

Referring to your editorial in *E.&M.J.*, issue of March 16, on "Defining Borderland Material Between Ore and Waste," may I suggest the term "less-ore" as not open to the criticism offered against "subore," in that it does not imply physical location, but rather sets forth in plain English, which usually is most acceptable in mining parlance, the fact that whereas this particular class of rock is not waste, it is less or lower in grade than what is recognized as commercial ore.

C. W. BAGWILL.

McGill, Nev.

By The Way

Flivvers Not Detroit's Only Staple Product

FAR BELOW the streets of one of Detroit's busy sections, a crew of men is engaged in mining 1,400 to 1,500 tons of salt daily in one of the largest salt mines in the United States. As traffic passes to and fro on the surface, 1,100 ft. below little cars make their way through the labyrinth of electrically operated tracks, which total more than five miles in length.

Dynamite is used to break down the salt walls of this mine, walls believed extensive enough to supply salt for the next 100 years. The dynamiting is done at night, in order that ample time may elapse to clear the mine of smoke before the workmen enter the galleries.

The long wait, however, is not essential, for an extensive and adequate ventilating system sends fresh air at the rate of 40,000 cu.ft. a minute down the shaft.

A special type of electric shovel is employed in loading the cars in the mine, huge scoops that take a 1,500-lb. bite into the piles of salt broken down by the miners with the aid of dynamite.

After ten or twelve of the little flat cars have been filled, an electric engine hauls them to the shaft, where they are turned over by a gravity system into the elevator cars by which the salt is hauled to the surface. On the surface the salt is crushed and shipped away.—*Detroit Daily News.*

Book Reviews

Flotation Research

FLOTATION FUNDAMENTALS, *Part 3. Technical Paper No. 5. By A. M. Gaudin and J. Shelton Martin. Published by the University of Utah in cooperation with the U. S. Bureau of Mines. Pp. 37. Figures, 24. Price, 35c.*

THIS paper records results obtained in an investigation which may be considered as a continuation of that covered by "Flotation Fundamentals, Part 1" issued about a year ago. Part 3 pertains to the flotation of pure azurite and malachite, and mixtures of malachite and various common gangue minerals. The following summary is presented by the authors:

1. Malachite and azurite can be floated from a siliceous gangue by means of suitably selected saturated fatty acids and fatty acid soaps.

2. Saturated fatty acids and fatty acid soaps will not effect a separation of the carbonates of copper from a calcite gangue.

3. The failure of the fatty acids and fatty acid soaps, in the flotation of malachite and azurite from calcite, has been shown to be due to the acid condition of the circuit, which results in copper and calcium ions being present in the solution, causing the formation of identical surfaces on both the copper and the calcium carbonate particles.

4. Several nitrogen-containing organic substances, such as amines and hydrazines, have been investigated as collectors of malachite and azurite. These compounds will float the carbonates of copper from calcite, but relatively large amounts are required.

5. Organic nitrogen-sulphur reagents, such as the thiocarbamates, are more powerful collectors of malachite and azurite than are compounds containing nitrogen but no sulphur.

6. The effect of a large number of xanthates, and other thiocarbonates, on the flotation of malachite and azurite from calcite, and other common gangue minerals, *without previous sulphidizing* has been investigated.

7. It has been shown that the xanthates and thiocarbonates collect as a result of the formation of insoluble copper compounds with the copper carbonates by chemical reaction rather than by adsorption of the reagent molecules on the mineral surfaces.

8. Malachite and azurite may be floated from calcite, and other gangue minerals, by means of relatively small amounts of suitably selected xanthates and other thiocarbonates.

9. Temperature, time of conditioning of the mineral with reagents, and grain size are important factors affecting the flotation of the copper carbonates with the xanthates and thiocarbonates.

10. An investigation of the effect of several organic hydrosulphides has shown that this type of reagent can be used to float malachite and azurite from calcite and other gangue minerals.

11. Organic hydrosulphides are collectors of malachite and azurite by reason of the fact that insoluble copper mercaptides are formed on the surfaces of the copper carbonate particles by chemical reaction involving the replacement of hydrogen by copper in the hydrosulphide molecule.

12. The amount of reagent required in floating the copper carbonates depends to a large extent upon the quantity of copper carbonate present.

13. The results of this investigation seem to indicate that copper carbonate ores may be concentrated by flotation by the use of suitably selected thiocarbonates (xanthates), or by means of organic hydrosulphides (mercaptans).

THE DETERMINATION OF HYDROGEN IONS. *By W. Mansfield Clark, 3d edition. The Williams and Wilkins Company, Baltimore, 1928. XVI + 718 pages. Price, $6.50.*

PERHAPS no book on chemistry in recent years has been accorded such a ready reception by such a large scientific public as was this book in its previous editions, writes J. Livingston R. Morgan in *Chemical and Metallurgical Engineering;* and certainly the names of few authors have become so completely identified with their subject in the minds of that public as is the case here. For this book presented for the first time the technique of hydrogen-ion determination, that subject so vital in chemical, industrial, biological, physiological and medical research, in one clearly written, authoritative volume; with the result that today the expressions "hydrogen-ion determination" and "*pH* value" have become practically synonymous with the name Clark, in the thoughts of numerous investigators and students.

This third edition, which is completely rewritten, is on a broader, more philosophical, more fundamental foundation than the others were, and has been considerably expanded both from the experimental and theoretical sides. From the experimental viewpoint this is especially to be noted in the treatment of the optical aspects, quinhydrone and related half-cells, metaloxide and glass electrodes, and in the chapter on applications; while from the theoretical side new chapters appear on changes of free energy, temperature coefficients, the theory of Debye and Hückel, on alternate methods of formulating acid-base equilibria, elementary theory of titration, and on non-aqueous solutions. All tables in the new edition have self-explanatory titles, which aid the reader materially; and the notation is in accord with the usage of the International Critical Tables.

This indeed is a book which should have a place on the "handy" shelf of the bookcase of everyone who is interested in physical chemistry in general, and which should be the constant companion of everyone who is determining hydrogen-ion concentrations, or is employing them.

THE TECHNIQUE OF PREPARING THIN SECTIONS OF ROCK. *By R. E. Head. Technical Paper No. 8, Utah Engineering Experiment Station. Salt Lake City, Utah. Pp. 29. Price 75c.*

THE work of preparing sections is described in minute detail in this pamphlet. Section grinding is generally considered a tedious operation requiring a great outlay of time, to say nothing of skill and patience. This conception, says Mr. Head, has probably been brought about by a lack of knowledge of the practice of direct and efficient methods of production which would result in a material saving of time and effort. Under proper working conditions, he says, practically anyone possessed of an average amount of native mechanical ability and a desire to prepare his own thin sections can learn to make them in a relatively short time. The time required depends largely upon the personal factor. The concluding seven pages are devoted to a discussion of the supplies and apparatus required for the work.

MIARGYRITE SILVER ORE FROM THE RANDSBURG DISTRICT, CALIFORNIA. *By Earl V. Shannon. Bulletin 2766 from the Proceedings of the U. S. National Museum. U. S. Government Printing Office. Pp. 11.*

MIARGYRITE, one of the rarest of the sulphantimonites of silver crystallizing in the monoclinic system, has been found in the United States only in the Flint and Silver City districts in Owyhee County, Idaho, and in the Randsburg district, California. In the latter district it has been abundant in the bonanza silver ores lately worked by the California Rand Silver Mining Company. The pamphlet is limited to a description of the properties and reactions of the mineral.

THE MECHANICAL WORLD ELECTRICAL POCKETBOOK, 1929. *Emmot & Company, Ltd., 65 King St., Manchester, England. Pp. 401. Price 1s. 6d.*

THE new edition of this little volume contains the same useful collection of data that has appeared in earlier editions, with such additions and editing as is necessary to bring it up to date. The compilation is one that the electrician and engineer will find of service and the size is small enough to justify the name of pocketbook bestowed upon it. It is prepared of course from the British viewpoint and is intended primarily for use in British countries, particularly Great Britain.

Personal Notes

Ira B. Joralemon, of San Francisco, recently left on a business trip to Europe.

H. L. Berkey, of Santa Rita Copper, operating near Tucson, Ariz., is in New York City.

Raymond B. Ladoo, manager of rock sales, U. S. Gypsum Company, is in San Francisco.

Walter Douglas, president of the Phelps Dodge Corporation, was a recent visitor in Bisbee.

W. J. Sharwood, of Homestake Mining, at Lead, S. D., is on a short visit to Berkeley, Calif.

H. L. Brown has gone to Cuba for a couple of weeks after spending some time in Nova Scotia.

Heath Steele has returned to New York from a trip to Mexico and southwestern United States.

W. F. Boericke, business manager of *Mining and Metallurgy,* was on a short visit to San Francisco recently.

Durand A. Hall, of Berkeley, Calif., has returned to his home after a trip to northern Chihuahua, Mexico.

H. C. Carlisle, mining engineer, of San Francisco, recently left for Europe. He expects to return about June 1.

B. T. Isrig's present address is wanted. Mr. Isrig's last address was Apartado 7, Cananea, Sonora, Mexico.

H. D. Quinby, mining engineer and metallurgist, has returned from Soyopa, Sonora, Mexico, to his home in San Francisco.

J. G. Clark, president of the Tungsten Production Company, of Boulder, Colo., left for New York on March 24 on a business trip.

R. H. Ormsbee, of Lovelock, Nev., has taken a position in the research department of the Phelps Dodge Corporation at Bisbee, Ariz.

L. B. Weed, general superintendent of the iron mines and lime quarries of the Colorado Fuel & Iron Company, has resigned, effective May 1.

T. P. Steers, of Eagle-Picher Lead, of Joplin, Mo., recently inspected the properties of the Steel Galena Mining Company, in Custer County, Colo.

R. C. Nowland, of San Francisco, was recently in Mexico, in the area near El Paso, Tex., where revolutionary activities are now at their height.

Livingston Wernecke, general superintendent, Treadwell Yukon, Ltd., at Mayo, Yukon Territory, is in San Francisco on his annual visit to headquarters.

Ernest V. Pannell, consulting electrical and metallurgical engineer, is now occupying offices in the Chanin Building, 122 East 42d Street, New York City.

L. M. Maitland has been elected president of the Hinsdale Mining, Milling & Smelting Company, which is developing a property at Cave Basin, Durango, Colo.

M. L. Hartmann has resigned as technical director of the Celite Company, operating at Lompoc, Calif., and will engage in consulting practice in Los Angeles.

Murray F. Crossette has been appointed superintendent of mines of Compañia Minera de Peñoles, S. A. **John Tallant** has been made assistant to Mr. Crossette.

C. W. Newton, general manager of Callahan Zinc-Lead, and **D. A. Callahan,** president of the company, are in New York to attend the annual meeting of the company.

Stanley R. Moore, mining engineer, of Wallace, Idaho, has returned to Wallace after a trip to Alaska, where he examined mining properties in the Chichagof and other southern Alaska districts.

Marden W. Hayward has been appointed consulting engineer for Compañia Minera de Peñoles, S. A. He will continue to have supervision over the geological department of that company.

S. H. Brady, formerly with Tonopah Belmont Development, has been appointed general manager of Katherine Gold, operating west of Kingman, Ariz., and will take active charge of operations at the mine.

Samuel B. Holbert, who was elected president and director of Dickens Consolidated, in the Coeur d'Alene district, to succeed C. H. Whittum about two months ago, has resigned from the company. A successor has not yet been named.

W. H. Bowering has just returned to Compton, Calif., after examining some gold mines near Mount Whitney, Inyo County, Calif. Mr. Bowering and his associates may undertake development of the property, which carries leached monazite ores.

V. M. Merandon du Plessis, of the Compagnie Royale Asturienne des Mines, Paris, has been in the United States for the last three weeks in connection with his company's activities in the reduction of zinc ores and the marketing of the metal.

Gerald H. Parkinson, mining engineer, until recently with the United Verde Copper Company, at Jerome, Ariz., sailed from New York on the "Berengaria," on March 29. Mr. Parkinson will spend several weeks in London, subsequently going to the Northern Rhodesia copper district, via Cape Town.

John Adam, underground manager of the Zinc Corporation, and **W. D. Whiteman,** of the British mine of North Broken Hill, of Broken Hill, New South Wales, Australia, sailed from Sydney early in March on a tour of the mining districts of Canada and the United States.

George F. Zoffman, mining engineer, formerly general manager of the Cinco Minas properties, State of Jalisco, Mexico, has been appointed manager of the Duval-Texas Sulphur Company, at Benavides, Tex. This organization is a subsidiary of the United Gas Company, owned by the Moody-Seagraves interests.

George Jay, purchasing agent for the Calumet & Arizona Mining Company, and **C. C. Lassiter,** of Douglas, traffic manager for the Phelps Dodge Corporation, left for New York City recently to attend a preliminary meeting of traffic managers of several copper companies in regard to hearings ordered by the Interstate Commerce Commission on railroad rates on non-ferrous metals.

Charles Bocking, formerly vice-president and general manager of the Granby Consolidated Mining, Smelting & Power Company, Ltd., has been elected president of the company to succeed the late Colonel J. T. Crabbs, who died in New York recently. **Charles Hayden,** of the banking house of Hayden, Stone & Company, which is closely allied with the Kennecott group of copper producers, was elected chairman of the board of Granby Consolidated.

L. O. Howard, of Pullman, Wash., recently visited the Spring Hill mine of the Montana-Idaho Mines Corporation, at Helena, Mont., in connection with the installation of flotation equipment to replace treatment by cyanidation in extraction of gold from the company's ore. Mr. Howard is also consulting engineer for the Knickerbocker Mines Corporation, which is reopening the old Bertha and Alta mines, in the Corbin-Wickes district of Montana, and consulting metallurgist for the Montana-Premier, which is developing a gold mine at Plains, Mont.

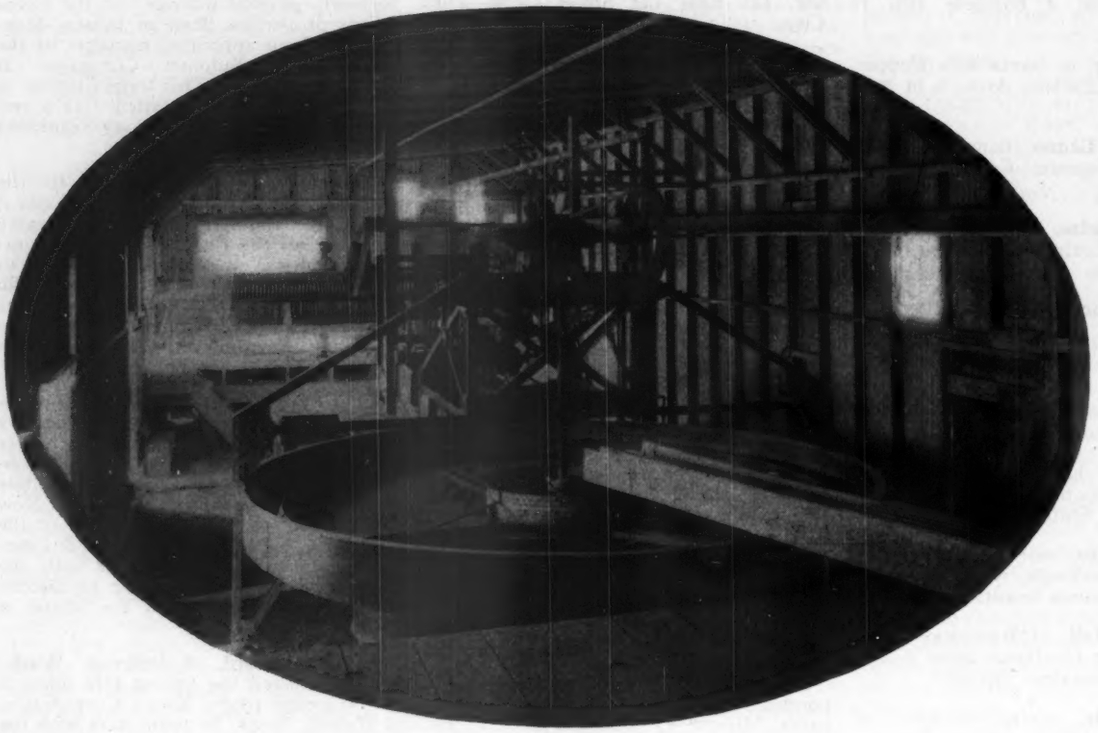
OBITUARY

J. W. Mooney, Toronto mining man, died suddenly in Ottawa, Ont., on March 27 from heart failure.

James W. O'Brien, discoverer of the Gold Belt mines, at Ouray, Colo., died recently in California at the age of 73.

William Y. Williams, mining engineer, died in Spokane on March 24. He was 75 years old and had been in the Pacific Northwest for the last 47 years. During this period he was intimately connected with the development of several important mining properties in the Coeur d'Alene and Kootenay districts, being superintendent of the Granby mine.

Benton Jackson Brown, assistant superintendent of the Chihuahua plant of American Smelting & Refining Company in the State of Chihuahua, Mexico, died at Chihuahua on March 9 of pneumonia, after a short illness. He was only 29 years old and leaves a wife and three-year old child. He was buried at Pasadena, Calif., the home of his parents, on March 12.



A modern clay-washing plant at Oglesby, Ill. The operator, the Illinois Clay Products Company, is using a bowl classifier, here shown, to separate the sand and grit. Contrast this practice with the older one of using sand-settling troughs shown below.

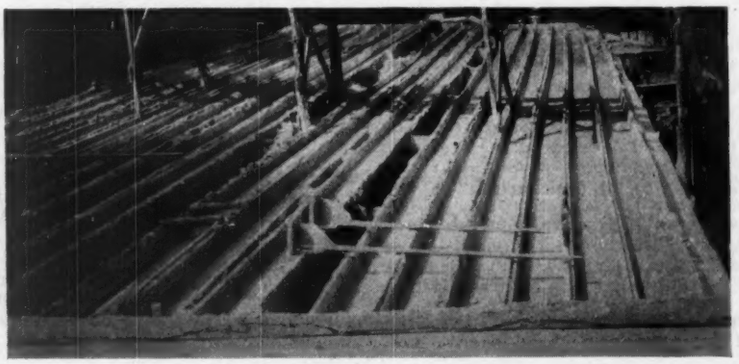
Modernized Treatment Improves Results in a Non-Metallic Industry—I

BY A. ANABLE
The Dorr Company, New York

TO ONE familiar with the highly efficient processes and equipment employed by the metal-mining companies for extracting metals from their ores, the methods used in some of the non-metallic mining industries seem astonishingly crude. Abundant opportunity appears to exist for the application of modern machinery. Nowhere is this more evident than in clay washing. In the following, the principles involved in washing clay will be discussed and a description given of various plants in which antiquated methods have given way in varying degree to modern ones.

Whatever be the method used in washing clay, the process necessarily includes three stages[1]: hydraulicizing, blunging or mixing the clay with water; removal of the non-clay particles, such as grit, sand and mica; and dewatering the clean clay slip. Removal of grit and sand by washing and subsequently removing the excess water from the grit-free product are steps common to many preparation processes, and to a certain extent are similar to those employed in hydrometallurgical practice. In the latter, the bowl classifier and

Several hundred feet of sand settling troughs representative of older clay-washing practice



[1] "Dorr Classifiers for Clay Washing," by A. Anable. A paper presented before the American Ceramic Society, White Wares Division, Atlantic City, N. J., Feb. 6, 1928.

thickener have long been used for producing uniformly fine water-floated ore particles and for recovering these fine particles as a dense thick sludge or slurry from which the greater part of the water has been removed. Several years ago, as set forth in the paper referred to in the accompanying footnote, a metallurgical equipment company entered the ceramic field, believing that there was enough in common between clay washing and ore classification to warrant the use of its bowl classifier. Its experience has demonstrated the correctness of this supposition.

The classifier selected for the work consists essentially of two main parts—the bowl and the washing compartment. Clay slip enters the bowl through a loading well at the center. The bowl forms a shallow quiescent pool or settling basin, which permits even the finest particles of sand to drop out, the purified slip finally overflowing as a thin film over a strip which extends completely around the circumference, forming in effect a circular weir. The size of the bowl is a function of the volume of clay slip to be handled and the deceleration of the rate of flow of the slip that will cause all the sand of a specified fineness to settle out upon the bowl bottom. Factors controlling the separation of sand and clay in a bowl classifier have been worked out to a nicety and results secured in practice can be predicted accurately from small-scale test work at an experimental station.

The sand deposited on the bottom of the bowl is moved toward the bowl center by plow blades attached to a set of slowly revolving radial arms. In passing into the rectangular washing compartment below the bowl through an interconnecting opening, the sand and grit are met by an upward current of water which tends to wash back into the bowl any clay which may have adhered to the sand. All of this water may be added as a spray through a perforated pipe near the discharge end of the washing compartment, and it is through this spray that the sand is raked for a final rinsing before being discharged virtually free from clay.

In the washing compartment a set of more rapidly moving reciprocating rakes not only move the sand up the inclined bottom and through the rinsing spray, but also impart a rubbing and turning-over motion to the sand, which frees by abrasion any persistently adhering clay. Patently, therefore, the grit-free clay slip is allowed to overflow from the bowl in a quiescent condition in order to assist the deposition of sand, while the sand is successively passed through (1) an upward current of water; (2) a rubbing and agitating zone; and (3) a water rinsing before it is allowed to escape from the system. It is the combination of these different treatments for the clay and the sand that assures a grit-free clay and clay-free grit as the two separated products.

Clay-washing plants, except where their processes have been modernized, commonly use settling troughs for removing the sand. This results in high loss of clay because of the fact that it is entrained in the settled sand. That the differential treatment possible with the bowl classifier cannot be effected with the settling trough is plainly evident.

A tray thickener for dewatering water-floated ochre at plant of Georgia Peruvian Ochre Company, Cartersville, Ga., where modern methods are used

The first successful classifier installation was made in California at a plant which washed Nevada china clay. It was followed soon after by an installation in Illinois, which washed a local clay deposit for terra cotta use. The former of these two was that of the American Grinding Company, Los Angeles. It was described in *Ceramic Industry*, April, 1924, by J. W. Wright and G. R. Boggs. According to the authors, the new plant enabled the company to substitute American clays for English clays at a substantial saving in manufacturing costs, thus demonstrating the value of scrapping obsolete equipment. It was said, moreover, that the new system of grinding produced a finished clay even superior to English china clay, and in addition turned out ground feldspar and flint of a grade that had previously been unobtainable from any source.

After crushing and grinding, the latter operation being performed in a Hardinge mill, the product is pumped to a small Dorr hydroseparator. where the coarser material settles out, the fines overflowing into a second and larger thickener. Here they settle gradually, undergoing, meanwhile, a slow blunging action and being drawn off progressively in semi-fluid form. From the thickener they are pumped directly to an American continuous filter. The coarser particles settled in the hydroseparator are pumped to a bowl classifier in closed circuit with the Hardinge mill for further regrinding, the finely divided bowl overflow being pumped to the thickener.

In 1924, when the plant went into operation, bowl classifiers had not been developed to the point where they could be depended upon to deliver a 300-mesh product, and for this reason the combination hydroseparator-bowl classifier layout was decided upon. Plants constructed since that time have eliminated the hydroseparator in favor of the large bowl classifiers, which have since proved capable of handling, unaided, any fine separation problem.

Another plant in which modern methods were adopted at about the same time was that of the Illinois Clay Products Company at Goose Lake, described in *Iron Trade Review*, Nov. 13, 1924. As described, this plant had a bowl classifier 2 ft. 3 in. wide and 21 ft. 4 in. long and equipped with a 12-ft. diameter bowl; also with a Dorr thickener 50 ft. in diameter and 16 ft. deep. Dewatering of the thickener underflow was effected in filter presses and a Ruggles-Coles type drier. The washing department of the plant pulped the fireclay in a clay washer, a long steel cylinder 3 ft. in diameter with a shaft through it and many cross rods that disintegrated the clay into a solution of about 90 per cent water and 10 per cent clay. This thin clay slurry flowed into a classifier with a 12-ft. diameter bowl, with revolving scrapers that automatically overflowed the clay in suspension that would pass through a 200-mesh sieve. The undissolved clay and foreign matter dropped to the bottom of the bowl and was conveyed through the reciprocating rake compartment by a rake mechanism, and the residue was discharged from the end. The clay slurry from the overflow section was pumped into a thickener 50 ft. in diameter and 14 ft. high, holding some 180,000 gal.

From the cone in the bottom of the tank the clay slurry containing about 50 per cent water was pumped by a pressure diaphragm pump into a filter press with 72 plates each 32 in. square. The filtering and thickening apparatus had a capacity of about five tons per

hour of dry clay, which was unusually fine grained and pure. This plant was built to remove pyrite and chalcopyrite from the Illinois fireclay by washing, so that the refined product might be used for terra cotta work. The rake product, consisting for the most part of mineral impurities, was discharged as a waste product. The capacity of the plant was five tons per hour and the thickener underflow from 38 to 40 per cent solids.

(To be concluded)

V-Belt Drive for Power Transmission Increasing in Popularity

IN THE last few years a noticeable increase has occurred in the use of elastic V-shaped belts in multiple instead of the ordinary flat-belt-type of drive or in place of chain drives. The V-belt drive is applicable to almost any type of service, and its use has solved many baffling power transmission problems, this accounting for the favor with which it has been received.

This type of drive has interesting advantages as compared with the ordinary flat-belt drive and in comparison with the direct connection of the motor to the driven machine. In the first place, very short centers are possible, so that minimum floor space is required. The speed ratios may be increased also, and higher-speed motors may be used than can be employed with the flat-belt drive. This reduces the initial cost of motor installation.

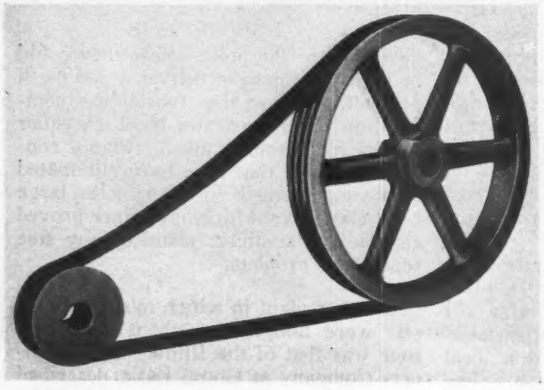


Fig. 1—A set of sheaves and belts for a typical V-belt drive.

The efficiency of the V-belt drive has been shown on numerous tests to be 98 per cent or better. This compares favorably with the best results obtained with the chain drive and is better than the efficiency obtained with flat-belt drives. The V-belt has flexibility, so that the driven machine is protected against breakage by sudden stoppage or shocks. It operates silently and eliminates vibration. No belt dressing or lubrication of any kind is required. The V-belt drive, therefore, requires practically no attention and the maintenance cost is low.

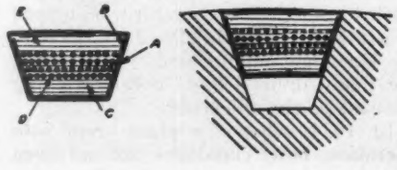
With a drive of the V-belt type, bearing pressures are greatly reduced. This is possible because much higher belt speeds can be used, and owing to the wedging action of the belts in the grooves, there is practically no tension on the return side of the V-belt. The total belt tension in this drive, while running, is practically equal to the driving tension, whereas with a flat belt the total tension while running is anywhere from two to six times the driving tension.

V-belts are available for transmitting power from a fraction of a horsepower up to two hundred and more horsepower, and may be used for either reducing or increasing speeds. In nearly all cases it is possible to secure them for any required center distances. This is made possible by the large selection of standard belt lengths in which the endless belts are available.

The most recent development in V-belt drives is known as the Flex-Mor drive, a product of Fairbanks, Morse & Company, of Chicago. The new drive is the result of numerous field and dynamometer tests made to determine the factors of belt angles, slippage, the life of belts of various constructions, character of the various materials entering into the drive, and power capacity.

The belts which are used with the Flex-Mor drive are built up of an outer belt jacket of duck which has been treated with rubber to improve its wearing qualities. As shown in the accompanying illustration, this jacket consists of two layers of duck enclosing a core made up of a layer of rubber, several layers of rubber-embedded cords, and another layer of rubber above the cords.

Fig. 2—Drive belts are built up of duck, shown at "A" and "B," special compounded rubber ("C" and "E") and layers of cork, shown at "D."



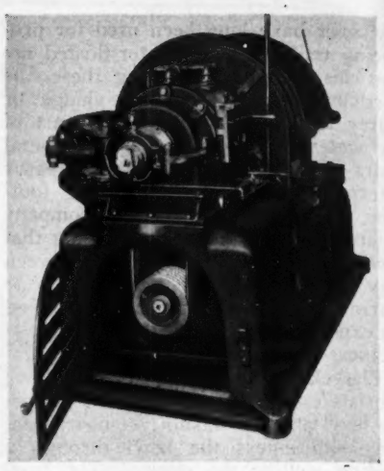


Fig. 3—A short center vertical drive, one of the most difficult belt drive problems, is solved with multiple V-belts.

The layer of rubber below the cords is specially compounded to withstand repeated compression, and the layer of rubber above the cords is specially compounded to withstand repeated tension. The rubber-embedded cords are laid at the neutral axis of the belt where there is the least tension or compression. These cords are made of long staple cotton and the construction is similar to that used in cord tires. The various elements of the belt are assembled in the mold and vulcanized together into a unified structure.

The sheaves are made of semi-steel and have been designed with particular reference to the angle and depth of the grooves, so that belt slippage is minimized. At the same time, the relation between the angles of the belt sides and the grooves is such that the belt makes a gradual contact with the grooves as it bends around the sheaves. Because of the wedging action of the belts in the grooves and of their inherent elastic qualities, sudden grabbing of the load does not take place and sudden shocks to the driving and driven machines are eliminated.

BULLETINS

GASOLINE HOIST—American Hoist & Derrick Company, 63 South Robert St., St. Paul, Minnesota. Folder.

ROCK DRILL—Chicago Pneumatic Tool Company, New York. Bulletin 851, CP-5 drifter. Twelve pages.

• SCREENS—Robins Conveying Belt Company, 15 Park Row, New York City. Bulletin No. 73, Vibrex screen. Eight pages.

COMPRESSORS—Chicago Pneumatic Tool Company, New York City. Bulletin 797, portable gasoline-engine driven compressors. Eight pages.

SKIP HOISTS—The Stephens-Adamson Mfg. Co., Aurora, Illinois. Skip-hoist catalog. Twenty-four pages.

HAULAGE—Van Dorn Coupler Company, Chicago, Ill. Folder, couplers. Four pages.

SWITCHES — Monitor Controller Company, Baltimore, Md. Bulletin No. 113. A. C. automatic starters. Eight pages.

NEWS OF THE WEEK

Summary

DEVELOPMENT of Golconda Lead and Dayrock Mining from prospects into dividend-paying mines within the last few months indicates that the Coeur d'Alene district is still far from exhaustion. Page 571.

* * *

Evans-Wallower Lead has made splendid progress in construction of its new 50-ton electrolytic zinc plant, and expects to have it in operation in June. Costs have been kept close to original estimates. Page 573.

* * *

Lake Shore will increase mill capacity at Kirkland Lake to at least 2,000 tons daily. Enlarged plant will not be in full operation till next year, however. Page 574.

* * *

The Locke brothers, George Shurtleff, Harry Carragher, and J. C. Anderson have been convicted in the Canario Copper trial. The last named was convicted on only one charge; the others were found guilty on two charges. Page 572.

* * *

Real del Monte will build a new 3,000-ton concentrator at its Pachuca properties, in Mexico, to replace the two mills now in operation. Page 574.

* * *

A French company, M'Zaita, has obtained control of the Chagres copper mines and smelter in Chile and will increase capacity to 10,000 tons of copper a year. Page 570.

* * *

Consolidated Coppermines is operating four diamond drills at its properties in the Ely district of Nevada, where some ore averaging 3 per cent copper has recently been struck. Page 570.

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Miners in the lead-producing districts of Utah have received a wage increase of 25c. a shift, because of the higher lead prices, although an increase is not called for by the sliding wage scale adopted in 1923. Page 573.

International Nickel to Build Refinery in Ontario With Consolidated M. & S.

Ventures Likewise in Agreement to Build Plant, With Initial Capacity of 120,000 Tons of Copper a Year, in Sudbury—Hudson Bay's Blister Will Probably Be Handled Also

ARRANGEMENTS have been completed whereby International Nickel, together with Consolidated Mining & Smelting, and at a later date possibly other interests, will build a copper refinery at Copper Cliff, Ontario, with an initial capacity for refining 120,000 tons of copper annually. Construction will be started at once and the new refinery will be completed and operating in about eighteen months. It will employ 600 men and will cost approximately $4,000,000. About 6,000 hp. of electrical energy will be utilized. Howard Ferguson, Premier of Ontario, has stated that the government had made arrangements whereby the facilities of this new plant will be available for custom copper. For this reason, as well as to take care of the increased production of copper incident to the preliminary development of the Frood mine, the initial unit is expected to be duplicated within a comparatively short time. Consolidated Mining & Smelting stated subsequently that Ventures, Ltd., and Sherritt-Gordon are associated with it and International Nickel in the construction of the refinery. Consolidated Smelting also states that the refinery will probably treat blister copper from Hudson Bay Mining & Smelting, operating the Flin Flon mine.

Co-ordinate with the announcement of plans for the refinery is the additional announcement that Canadian Industries, Ltd., will in the near future erect a sulphuric acid plant at Copper Cliff in close proximity to the new smelter being erected by International Nickel, and that the first-named organization will go into the marketing of sulphuric acid on a fairly large scale. It will probably be engaged in making from part of this acid one of the fluxes needed in the nickel refining operations. Contracts have been signed between International Nickel and Canadian Industries for a supply of fluxes for several years. The cost of the acid plant is estimated at about $1,500,000. The sulphuric acid plant of Mond Nickel, at Coniston, has also been leased to Canadian Industries. Establishment of the proposed Canadian Industries plant is likely to lead in the future to the manufacture of heavy chemicals, and it is believed to be the first step in the establishment of a very large and important chemical manufacturing industry.

Good progress is being made with the development of the Frood mine and with the construction of the mill and the new Copper Cliff smelter. The smelter foundations are practically ready for the steel work in which 20,000 tons of steel will be employed. When complete, the smelter will have a height of more than 200 ft., as it is proposed to superimpose the roasters over the reverberatory furnace. The mill is being designed for a capacity of 5,000 tons a day. In addition to this, 3,000 tons a day of smelting ore will be mined, making a total of 8,000 tons of ore a day to come from the mines. The mill will be designed to permit of the easy separation of part of the copper ore, which will be converted directly into blister copper, instead of into matte, as has previously been the custom at Sudbury.

Develop Gold Property in North Wrangell District

George S. Cochran, mining man, of Seattle, has taken an option on a property near the Nabesna River, in the North Wrangell district, Alaska. It carries high-grade free gold ore. Mr. Cochran is planning to use an airplane for transportation to and from the property this summer. A considerable part of the North Wrangell area will probably be mapped by aërial methods during the winter of 1929-30. Carl F. Whitham is in charge of operations.

Extend Tunnel Near Prescott

The Senator tunnel, near Prescott, Ariz., will be extended a distance of 1,100 ft., making a total length of 4,500 ft., by Bluford H. J. Balter, who has obtained an option on the property from Phelps Dodge. The property adjoins the Storm Cloud, owned by Mr. Balter, which is now shipping about six carloads of concentrates a month. Mr. Balter recently bought the Verde Superior group, in the Ash Creek district.

Con. Coppermines Drilling Ground Near Alpha Shaft

FOUR diamond drills are being used by the Consolidated Coppermines Company in ground adjacent to the Alpha shaft at Kimberley, Nev. Two are owned by the company and two by Lynch Brothers, of Seattle. The first hole struck oxidized copper ore and a drift extended along the course of the hole has produced two carloads of ore carrying from 3 to 10 per cent copper.

The present program of the company calls for drilling of at least six holes, each 500 ft. long. All of this drilling will be done above the 1,000 or water level. If results justify, drilling will also be done below the water level. Construction of another bunkhouse has been started and the first of three 600 hp. Diesel engines has arrived. These engines will be installed at the Emma-Nevada three-compartment shaft to augment the present power supply.

Shipments from the Monroe claim, on the south side of the Ruth pit, have been started. This ore, carrying about $40 a ton in silver and lead, is being shipped to Salt Lake City smelters. An airline has been extended to the new prospect from the Emma-Nevada shaft.

Small Park City Mines Continue Activity

DEVELOPMENT work at the non-producing mines in the Park City district, Utah, is being energetically pushed. At the Park Premier, the International Smelting subsidiary, development is being centered on a 10-ft. quartz fissure opened up in the upper tunnel. Equipment for sinking has been ordered.

Park King Mining, which adjoins Park Utah, has cut a station on its 300 level, and is crosscutting the Ontario quartzite north and south to strike the eastern extension of the Hawkeye-McHenry fault zone, with which the Park Utah orebody is associated. East Utah, which also adjoins Park Utah, is crosscutting the Hawkeye-McHenry fissure system. Easement through the East Utah tunnel has been granted to Mayflower Mines, which plans driving an adit into its newly acquired Park Bingham and Park Galena ground.

Two Die From Gas at Monarch-Rand Property

At the Monarch-Rand property, in the Randsburg district of California, E. C. Marshall, superintendent of the mine, and J. A. Marshall, his brother, were fatally gassed on March 25, 1929. The property had been shut down for a considerable period, and the two brothers entered the mine, being lowered in the shaft. It is assumed that they were overcome by the gas and were unable to signal to the surface. A rescue party entered the shaft, but encountered bad air at the 600 level and was forced to return. After five hours the mine was sufficiently cleared to enable another party to reach the bodies of the Marshall brothers.

French Company Acquires Control of Chagres

CONTROL of the properties of Compañia de Minas y Fundicion de Chagres, in Chile, has been acquired by Compagnie Minière du M'Zaita, a French company with interests in Europe and Africa, which is also acquiring properties in Chile. The consideration is said to have been 16,000,000 francs. M'Zaita will provide the necessary capital for the development of the mines at Melon and for the construction there of a concentrator with an initial capacity of 500 tons a day. The mines of the Melon group carry ore containing 3 per cent copper. In addition, the Chagres smelter will probably be increased to a capacity of 8,000 to 10,000 tons of copper a year. Last year the smelter produced 2,527 tons.

Silver Producers Lose Suit Against Government

SILVER producers have lost in the District of Columbia Court of Appeals a suit which would have cost the government about $6,500,000. They sought an injunction to require the treasury to buy silver at $1 an ounce to build up its stock of silver dollars to a point allegedly specified by the Pittman Act, but the court upheld lower court action by dismissing the suit.

The decision by Justice Van Orsdel upheld the ruling of the lower court that the companies did not have sufficient legal interest to file such a suit and added that even if the court should order the Secretary of the Treasury to buy the silver at $1, there was nothing in the record to show that these companies would benefit. The petitioners were the American Silver Producers' Association, Dellas Consolidated Mines, and Spar Consolidated Mines.

Develop Gold Mine in Southern Nicaragua

A MINING PROPERTY in the district of La Libertad, Nicaragua, has been incorporated by J. M. Nicol, of San Francisco, and his associates. The company is known as the Babilonia Gold Mines, Inc. Its properties include 355 acres of mining claims as well as timber lands and water-power sites in the southern part of Nicaragua, 45 miles east of the Lake Nicaragua, and accessible by government road from Puerto Diaz.

Present plans include the installation of mill equipment to increase production to 1,000 tons of gold ore per month. J. M. Nicol is manager and William Hanna, of La Libertad, is mine superintendent.

Burma Strikes High-Grade on No. 9 Level

A CROSSCUT east of the No. 9 level on the Shan Lode, at the Bawdwin mine of Burma Corporation, in Burma, has struck two veins of high-grade ore, according to D. Anderson, secretary of the company. The crosscut was driven at a point 259 ft. north of the shaft. At a distance of 47½ ft., a vein of silver-lead-zinc ore was struck which averaged 23.3 per cent lead, 26.6 per cent zinc, and 22.4 oz. of silver to the ton. The width of the vein was almost 8 ft. Another vein was struck after about 40 ft. of additional crosscutting. This averaged 58.6 per cent lead, 10.5 per cent zinc, 0.3 per cent copper, and 52.2 oz. of silver to the ton, over a width of 8¾ ft.

Build Flotation Plant in Thames District, New Zealand

A new effort is being made to treat the complex ores of the Thames gold district, in New Zealand. The Waimo Sulphide Corporation has been registered with a capital of £50,000 to acquire the Zeehan claim, in that district, and to complete the erection of a plant for the treatment of 50 tons of ore daily. A Minerals Separation & De Bavay's flotation unit will be included in the mill. The ore contains all five of the major non-ferrous metals —gold, silver, copper, lead and zinc. E. G. Banks, general manager of Waihi Gold Mining, is one of the directors of the new company.

Shipping Copper From Mines Near Battle Mountain, Nev.

High copper prices have stimulated output from the Copper Basin and Copper Canyon properties, of Copper Canyon Mining, near Battle Mountain, Nev. The output is being shipped to the International smelter at Tooele, Utah. J. C. Brumblay is in charge of the Copper Canyon operations. During 1927, these properties shipped an average of about 25 carloads of 12 per cent copper ore a month.

Six sets of leasers are employed at Copper Basin. Good and Kinneberg, leasers, are shipping a carload of 13 per cent copper ore every two days.

Fourth Advance Made in Wages at Copper Mines

Wages in the Arizona mining districts have been increased 5 per cent, based on the scale in effect Oct. 1. This is the fourth increase for copper miners since October, and goes into effect April 1. The total increase to date has been 25 per cent. No announcement has been made concerning a fourth wage increase in Montana, Utah, or Nevada as yet, but probably producers in those states will follow suit.

The Golconda mine and mill near Wallace, Idaho

Two New Coeur d'Alene Dividend Payers Were Developed Rapidly

Golconda Mill Started Operations Only Last August, but Is Already Earning $20,000 a Month—Dayrock, Originally Worked by Stratton Interests, Has Paid Back Entire Capital

TWO new dividend payers have been added to the long list of profitable operations in the Coeur d'Alene district within the last month—Dayrock Mining and Golconda Lead. Dayrock paid a dividend of 3c. a share on March 30, on 1,692,300 shares of stock outstanding, the total disbursement amounting to $50,769. Golconda paid a dividend of 2c. a share on 2,000,000 shares, amounting to $40,000. Both of these properties were only prospects a year or so ago, and their development into mines makes an interesting story.

The Golconda mine is about two and a half miles west of Wallace, Idaho. The property was originally known as the Hector, and was developed by a crosscut tunnel almost a mile long, as well as by numerous other lateral crosscuts. Failing to find ore or sufficient encouragement to proceed further, the effort was finally abandoned, and the Hector was idle for many years. Then a former employee with a good memory recalled that a little lead-silver ore was found in a fissure about 3,000 ft. from the portal of the tunnel. He secured a bond and lease on the property and with associates proceeded to develop it. This resulted in discovery of an oreshoot, which proved to be about 300 ft. long, much of it of shipping grade. A raise proved ore 200 ft. above, but it was smaller.

Confronted with sinking, the leasers, who in the meantime had incorporated Golconda Lead Mines, turned control over to a promoting organization in Spokane. Funds were provided through a rather spectacular stock-selling campaign, a shaft was started from the main tunnel level, and plans were prepared for a 200-ton flotation mill. Grave doubts were expressed regarding the persistence of the ore at depth, but no very satisfactory reason for this doubt was ever given. Construction of the mill started. At a depth of 200 ft. the oreshoot was larger than above, containing some zinc along with the lead. Last August the mill was ready to operate, and since that time has been working at capacity. Declaring a dividend so soon after starting production raised a question regarding earnings, which was met by a statement from the management that the company was earning a net profit of almost $20,000 a month and that the dividend was paid from the surplus earnings and would be maintained quarterly.

On the new level 200 ft. below the tunnel level, called the 1,200 level, the oreshoot is reported to be 700 ft. long and averages 6 ft. wide. Another 200 ft. has recently been added to the depth of the shaft and the vein crosscut on the 1,400 level. The ore, where crosscut, was 10 ft. wide, and drifts have been run east and west 150 ft., disclosing the same amount of ore, of good milling grade.

The company is planning to sink a new shaft, as the present one, and the hoisting facilities also, are wholly inadequate. Consideration is also being given to increasing the capacity of the mill, but this will probably be deferred until the new shaft is in service.

Golconda recently acquired by purchase the Mayflower group of claims, which adjoins it on the south, and through which the operating tunnel passes. Two Mayflower veins are also being developed with encouraging results. The new shaft will be located with the view to production from the Mayflower also.

The Dayrock dividend of 3c. per share is the exact price paid for stock by original stockholders in the Strattons Mines company, the name under which the company was first incorporated about five years ago. No assessments have been levied, the mine literally paying for its own development, and stockholders who held on can sell their holdings in the open market for about $2.50 per share.

Control of Dayrock is now owned by Hercules Mining. This corporate name was adopted a few months ago, replacing Strattons, and is a combination of Day and Rothrock. The Day interests control the Hercules, and Frank Rothrock is closely affiliated with the Day interests. Development of the Dayrock is unique in that up to about a year ago all work was done by hand labor, and to a great extent this is still the method employed. About a year ago an air pipe line was laid from the small compressor at the Panhandle property on the opposite side of the canyon, but the power obtained from that source is much short of requirements. The oreshoot in the discovery tunnel proved to be 600 ft. long, having a persistent streak of high-grade lead-silver ore, which varies from a few inches to 2 ft. in thickness and also contains from 1 ft. to 5 ft. of lower-grade material. From this tunnel an incline shaft has been sunk 300 ft. and the vein explored with satisfactory results on the 100, 200, and 300 levels. More recently development has been directed mainly to the 300, where drifting has proved the oreshoot practically continuous for 1,600 ft., ranging from 2 to 10 ft. in thickness. Shipments average about twenty carloads of ore a week, the ore being delivered to the Hercules mill at Wallace, two and a half miles away.

Rumors are persistent that the Dayrock will soon start sinking a vertical three- or four-compartment shaft and equip the mine for large production, results of development apparently justifying that move. The company also owns control of Option Mining, which adjoins the Dayrock and upon which an important discovery has been made in a parallel vein.

Canario Copper Promoters Are Found Guilty

AFTER a trial that lasted more than six weeks, in New York City, John C. Locke, Herbert T. Locke, George Shurtleff, and Harry C. Carragher on March 29 were found guilty of conspiracy to use the mails to defraud and of plain fraud in the case of the Canario Copper Company, and John Carter Anderson received an adverse verdict on the conspiracy charge only. The maximum penalty is five years' imprisonment and $5,000 for each count of 24 counts. The defendants were released on bail for sentence on April 5, by Judge John C. Knox, who presided over the trial. The Locke brothers, who were at the head of Cameron, Michel & Company, a stock brokerage firm, were alleged to have defrauded investors in Canario and other Mexican mines of more than $5,000,000.

The trial itself attracted a great deal of attention. The first three weeks were spent in hearing testimony of the investors who had put their money in Canario and also of employees of the Locke brothers, who testified as to the methods used in stimulating interest in the company's shares. Subsequently the government's chief witness was John Wellington Finch, lecturer on geology at the Colorado School of Mines, who visited the properties in Mexico in 1928. He testified, among other points, that a surface examination of the Batamote mine, one of the Canario holdings, was "sufficient indication to one familiar with interpreting the geological formation that there were no copper sulphide deposits of commercial value there." According to circulars issued by the promoters, the production of the Batamote mine was to have been $6,000,000 of ore a month. Mr. Finch was asked if he had ever, in his experience as a mining engineer, "given a negative report on a property which subsequently became a paying mine." To this question he answered "No."

John H. Dunning, Dr. John M. Banks, and Mr. Anderson, all mining engineers, testified that in their opinion the Canario properties could have been worked at a profit. Mr. Dunning stated that be believed the mine could be operated profitably with ore containing 1½ per cent copper, whereas Mr. Finch had placed the limit at 3½ per cent. However, Mr. Dunning stated that he believed 40,000,000 tons of ore would be needed to make 1½ per cent copper material profitable.

Dr. Banks testified that there were 30,000,000 tons of copper ore blocked out at the Batamote mine and that he believed that it could be worked at a profit of $1,750,000 a year, if the grade of 1½ per cent copper could be maintained. Mr. Anderson stated that during the period he was in charge of operations, from 1923 until 1927, Cameron, Michel & Company spent $338,179.49 for development of the mines. He repudiated statements attributed to him in circulars sent out by the company and said that he had objected to their use. He also said that he had never owned, bought, sold, or profited in any way from the sale of the stocks.

Lowell Wadmond and Elbridge T. Gerry, 3d, conducted the prosecution for the government.

Will Build Railroad Spur to Duval-Texas Sulphur

FOR the purpose of affording a rail outlet for the sulphur mines of Duval-Texas Sulphur, near Benavides, Tex., the San Diego & Gulf Railroad has been incorporated and will immediately start construction of a 3-mile line from the mines to an intersection with the Texas-Mexican Railroad, according to J. W. Cain, president of both companies. The Duval-Texas Sulphur Company has awarded the contract for the installation of a second battery of boilers and other equipment which will double the mining capacity of its plant. This addition will be completed about June 1. The first unit of the plant began operations Nov. 1, 1928, and has brought about 15,000 tons of sulphur to the surface.

Park City Consolidated Strikes Ore in Shaft

A good showing of ore has been exposed in the shaft of the Park City Consolidated Mining Company, one mile from Park City and adjoining the Park Utah to the north. When first struck, the vein was 4 in. wide. This rapidly widened to 4½ ft. showing in the shaft for 40 or 50 ft. down to the 300 level, where a station is being cut near the contact of the Park City limestone with the quartzite. From 12 to 16 in. of the vein filling is high-grade ore. The remainder is said to be all commercial ore, with silver content predominating.

Old Colony Moves Equipment to Portal of 4,200 Level

Old Colony Mines, at its property, 12 miles north of Kingman, Ariz., has completed work for the present in the tunnels at the 5,100 level, 4,800 level, and 4,500 level, and has moved all its machinery to the portal of the 4,200 level tunnel, where a centralized plant is being built. At this site a change room, boarding house, offices, compressor plant, and concentrator are being erected.

New Quincy Increases Output

Production of lead-silver ore from the New Quincy mine, in the Park City district, Utah, has been increased to 150 tons a day. The main stope associated with the 1,238 fissure has been opened up for a width of 60 to 70 ft. and a thickness of 40 ft. Sufficient ore has been developed along fissure 1,227 to indicate that the entire distance of 165 ft. between the parallel veins is one bedded deposit.

Interest Shown in Two Camps Near Goldfield, Nev.

TWO old gold discoveries, near Goldfield, Nev., that had been practically forgotten, are again attracting the interest of local mining men as the result of recent developments. In the early days of the Goldfield district, gold ore was reported in the mud and clay of Gold Lake, 15 miles east of Goldfield, and a large portion of the flat was located as placer ground. A shaft was sunk to 180 ft. at the northern end of the lake, but such mineralization as was found was evidently not commercial, for no further work was done and all the locations were allowed to lapse.

The lake is 3 miles wide and 5 miles long, and is perfectly dry except during local storms, as the water sinks quickly into the hard clay. Recently some California mining men sampled the material, and evidently the results were satisfactory, for the entire lake has now been staked out, an area of about 9,600 acres. Cyanide tests have been made on the material with considerable success. Additional sampling is now under way, and if it is as favorable as the preliminary results, extensive development will start at once.

About 65 miles east of Goldfield, the camp of Gold Reed is once again the center of interest. In 1906 O. K. Reed made the first discovery, from which a small production of about $75,000 was obtained. A camp of almost 500 inhabitants was established in the first year, but it was soon abandoned, except for Mr. Reed and his brother, Ed Reed. They continued development at intervals and now appear to have justified their faith in the camp by the development of new orebodies. Quite a rush is on from Goldfield and Tonopah, and many locations have been made.

Concreting Shaft Delays Sinking at United Verde

Sinking of the two main shafts from the 3,000 level to the 5,000 level at the United Verde mine, near Jerome, Ariz., has been delayed by concreting operations on the No. 6 shaft between the 2,100 and 3,000 levels. As soon as this work is completed, however, sinking will be started. The company has not definitely decided what plan to follow in sinking, but probably one shaft will be sunk to 5,000 ft., a drift run to the position of the other shaft, and then a raise put up.

Liberty Montana Installs New Power Equipment

Liberty Montana Mines, operating the Mammoth and other properties in the south Boulder district, near Cardwell, Mont., has just completed a $50,000 power installation. The company purchased a Sullivan angle compound compressor, which will be connected to a water wheel, according to F. R. Springer, managing director of the company.

The new electrolytic zinc plant being built at East St. Louis by Evans-Wallower Leaa

Evans-Wallower Electrolytic Plant to Be Ready in June

PROGRESS of construction work of the new 50-ton electrolytic zinc plant of Evans-Wallower Lead, at East St. Louis, Ill., bids fair to set a new mark for speed of construction of plants of similar metallurgical design. Announcement was made in August, 1928, of the construction of the plant, and ground was actually broken about Sept. 1. The accompanying illustration shows the present status of construction.

Unless unusual delays are encountered, it seems probable the plant will be started in June of this year. The grade of metal produced at East St. Louis will be equal to the Tainton electrolytic zinc now being produced at the Sullivan electrolytic plant at Kellogg, Idaho.

The acid outlet through the Monsanto Chemical Company and the site on which the present plant is being constructed will permit enlarging the plant to a capacity of approximately 150 tons of electrolytic zinc daily, according to Foster S. Naething, who is in charge of the construction work. It seems probable that the cost of the completed plant will not exceed the cost originally estimated by the metallurgical and construction engineers of the company, or about $1,000,000.

Waihi Options Dredging Ground in Siam

WAIHI GOLD MINING has acquired an option on several hundred acres of alluvial ground on the island of Puket, in Siam, about six miles from Tongkah Harbor. The company has discontinued diamond-drilling operations on its properties in New Zealand, as no new orebodies have been found. For the reason that no additional properties could be found in New Zealand, the company decided to look in other fields. E. G. Banks, general manager, went to Malay, and the option on the Puket properties is the result. On completion of arrangements now under way for taking over title to the ground, the company will obtain the necessary dredges.

The company operates the Union and Waihi-Silverton mines, in New Zealand, from which 228,749 tons was mined in 1928, with a production of 76,826 oz. of gold and 409,093 oz. of silver. Ore reserves on Dec. 31, 1927, were only 295,386 tons.

Silver Bow Consolidated Finishing Flotation Plant

Silver Bow Consolidated Mining & Milling is completing construction of a 50-ton flotation plant on its Blue Horse mine, in the Silver Bow district of Nevada. This mine has a record of a considerable production of high-grade silver ore, but no work had been done for several years when the Silver Bow company took it over recently.

The company is operating two compressors at different points on the property, and has just completed installation of an electric lighting plant. The mill will probably be started within two weeks. Sufficient ore has been proved to assure a steady supply for the mill. Harold Leighton is in charge of operations.

Tunnel at American Boy Nears Completion

A contract for driving the tunnel to the 2,650-ft. point at the American Boy property, in the Santa Rita Mountains, Santa Cruz County, Ariz., has been let, according to Albert F. Gross, who is trustee for the syndicate that is developing the property. The tunnel is now complete to 2,170 ft. When the tunnel has reached its destination, a raise will be driven to the old workings, from which shipments of high-grade ore, containing gold, silver, lead, and copper, have been made.

Will Sink Shaft at Nabesna

A shaft will be sunk on the property of the Nabesna Copper Corporation, in the Nabesna district, Alaska, during the summer, under the direction of D. C. Sargent, who has just taken in a large crew of men. Diamond drilling on the property last summer showed bornite and chalcopyrite orebodies on Orange Hill.

Utah Lead Miners Also Share in Wage Increases

LEAD miners in Utah's three principal lead-mining districts—Tintic, Bingham, and Park City—have been granted a wage advance of 25c. a shift, effective March 16. About 5,000 mine and mill employees are affected by this increase, which follows announcement of a raise in wages of 50c. in the Coeur d'Alene district. Wages at copper mines in the Salt Lake Valley have been increased about $1 a day in the last year, as have wages at the copper and lead smelters. This fact undoubtedly influenced the lead producers in increasing wages, as an increase was not called for by the wage scale adopted in March, 1923, when lead was 8.25c. a pound.

Mason Valley Smelter Is Still Operating

Mason Valley Mines has decided to postpone shutting down its copper smelter at Thompson, Nev., probably because of the high prices now obtaining for the metal. Operations will be continued until further announcement. If the smelter is closed later in the year, the management of the company states, custom ores will still be accepted at the Bluestone concentrator. Concentrates will be shipped to a Utah smelter.

On March 1 the company raised wages of employees 50c. a day, to keep the wage scale equal to the standard at other Western copper mines.

Park Utah Drifting on 1,950 Level to Cut West Orebody

Park Utah Consolidated Mines has started drifting on the 1,950 level to cut the west orebody on this horizon, after installing pumps with a capacity of 5,000 g.p.m. A drift will be started later to cut the east orebody, the first developed in the mine. Exploration of the Park City limestone formation, overlying the Ontario quartzite, from which most of the company's output has come since the first strike in 1920, will be started in the near future.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Lake Shore to Increase Its Mill Capacity Again — Hollinger Output Low

TORONTO, Ont., March 30, 1929.—Harry Oakes, president of Lake Shore, in the Kirkland Lake district, northern Ontario, announces that a program for the expansion of mill capacity has definitely been decided upon. Preparations are now being made to increase mill tonnage from its present figure of 1,400 tons to at least 2,000 and possibly 2,300 tons daily. Several changes will have to be made in the location of surface equipment. The mill must be enlarged to permit installation of new tube mills and filters, and the office building will have to be moved. To complete the work is expected to take a year, and the entire plant will not be operating at full capacity until the spring of 1930.

LAKE SHORE is already the foremost producer in the Kirkland Lake district. Shaft equipment at both its producing shafts is said to be capable of handling 2,000 tons daily. With regular production at this figure, and grade of ore maintained at about $16 a ton, the mine's output would pass $10,000,000 a year and would make it a serious rival to Hollinger Consolidated for supremacy among America's gold mines.

Hollinger tonnage is still low. At present the company's mill is treating about 4,400 tons daily from the mine in the Porcupine district, and no evidence of an early increase has been given. Last year's production is estimated at $10,650,000 from about 1,750,000 tons. This compares with 2,178,329 tons and $14,463,172 in 1927. Recovery in 1928 was only $5.98 a ton, compared with $6.64 in 1927. The average daily tonnage in 1928 was 5,081, whereas in 1927 it was 6,050. The Hollinger mill is equipped to handle 8,000 tons a day.

Development work at the McVittie-Graham property, on Moose Lake, in the Sudbury district, will be accelerated by the installation of a new 600-cu.ft. compressor. The shaft is now down 250 ft., and crosscuts are being driven east and west through the mineralized zone. Diamond drilling is also being continued. F. M. Connell, Noah Timmins, and British Metal have equal interests in this enterprise.

A special meeting of shareholders of Gold Hill Mines, operating in the Boston Creek district, northern Ontario, has been called to consider a proposal to increase the capitalization from 5,000,000 shares to 6,500,000 shares, to enable the company to complete its program of development. Since last July, when work on the upper levels was stopped, the shaft has been sunk from the 800 level to the 1,100 level. At this point the veins had widened considerably, and several new veins were struck. New orebodies are expected on the lower levels, east of the shaft. Should this probability become a fact, work will be concentrated on this section, and a winze put down to test the downward continuation of the orebodies.

Reject Proposal for Railroad to Woman Lake

A BILL was recently introduced into the Ontario Legislature incorporating the Northern Lines Railway & Development Company, authorizing construction of a 40-mile light railroad from Gold Pines, in the Patricia district, to the Woman Lake area, in northern Ontario. However, it was strongly opposed, and on March 26, when presented before the Railway Committee, it was rejected by a vote of 22 to 13.

Isle Royale Will Develop Ground Below No. 2 Shaft

At Isle Royale, in the Michigan copper district, a large area lying below and tributary to No. 2 shaft will be opened by sinking and drifting. The shaft is not as deep by 600 ft. as No. 4, and is 400 ft. shallower than No. 5. The greater part of the ground in Nos. 4 and 5 is of stoping quality, and if equally good vein matter is opened in No. 2, Isle Royale will have three productive units. Opening work in No. 2 did not get under way until the end of the last year, as it took considerable time to pump out the shaft and make repairs. Drifting was started on the No. 33 or bottom level, to the north.

Second Automatic Casting Machine Installed at C. & H.

The second and final automatic casting machine is being installed in the new furnace department of the Calumet & Hecla smelter at Hubbell, Mich. The metal flows from the furnaces directly into the machine, where it is cast into the desired shapes without handling. The new furnaces and automatic casting equipment (the latter made in the company's shops) are effecting notable economies in the smelting department.

Paramount Mining Buys Two California Properties

Paramount Mining has acquired the Mayflower drift property near Onion Valley, Plumas County, Calif. Several years ago, an 800-ft. tunnel and raise proved the channel, but further work was not attempted at the time. The same corporation has also taken over the Pride hydraulic property, on the North Fork of the Yuba. E. A. Stent is president and W. A. Hunter is manager.

Mexico City Letter

BY W. L. VAIL

Special Correspondent

Real del Monte Will Build New 3,000-Ton Mill at Pachuca Properties

MEXICO CITY, March 26, 1929.—Real del Monte, U. S. Smelting Refining & Mining subsidiary in Mexico, has recently presented an outline of its new program for operations to the Mexican government, this action being necessary under Mexican legislation if dismantling of plants is intended. The company states that to continue present operations a new metallurgical plant will have to be built to increase efficiency in operation and insure the margin of profit.

When finished this new concentrator will have a capacity of about 3,000 tons of silver ore daily. Construction is expected to cost 3,000,000 pesos, or about $1,300,000. The number of men employed will be materially decreased, but the construction of the plant is expected to insure permanence in output for several years. The two existing plants at Pachuca, which have a combined capacity of about 3,000 tons daily also, will be scrapped. Part of the equipment may be used on other properties belonging to the company in other parts of Mexico.

A GENERAL review of the mining situation throughout Mexico would indicate that only about 2 per cent of 554 operating mines are seriously affected by the present revolution. Parral appears to be without means of communication, and many districts in Chihuahua and Sonora have been affected. The Chihuahua smelter of A. S. & R. is running on ore and concentrate from Santa Eulalia, but shipments from Parral have been entirely cut off. The smelters at Torreon and Monterey continue to feel the results of lack of transportation, as mentioned in this column last week. This situation seems likely to continue for some time, as the Mexican government's early optimism is hardly warranted by developments on the "front."

A program for the modification of those parts of the mining law which conflict with constitutional rights has been made public this week by President Portes Gil. However, this will probably have to wait until the regular session of Congress, in September, as the permanent Commission of Congress is not expected to tackle it. The principal alteration applies to rights acquired prior to the Queretero Constitution of 1917. These changes do not include protests from mining chambers and producers against many clauses of the present law which are considered detrimental to mine development. These protests will be considered separately by the convention of mine operators, which is scheduled to meet in this city as soon as the revolution has been subdued.

Societies, Addresses, Reports

Tentative Program for Zinc Institute Meeting Announced

ALTHOUGH the complete program for the eleventh annual meeting of the American Zinc Institute, at St. Louis, has not yet been arranged, according to S. S. Tuthill, secretary of the organization, most of the principal items have already been fixed. On April 15, the opening day of the meeting, William E. Humphrey, one of the commissioners of the Federal Trade Commission, will speak on the work of the commission. Dr. Hugh P. Baker, manager of the trade association department of the U. S. Chamber of Commerce, will talk on the "Latest Developments in Trade Association Work." Traffic will be discussed by W. A. Moore, who is in charge of traffic for the New Jersey Zinc Company.

April 16 will be devoted to a discussion of the necessity of technical and market research in the zinc industry, in the morning, and to a meeting of the board of directors in the afternoon. For those who are not directors, a golf tournament has been arranged by E. J. Greve, chairman of the arrangements committee.

Dr. Charles Camsell, Deputy Minister of Mines, Department of Mines, Ottawa, Canada, will discuss Canadian

S. S. TUTHILL

zinc conditions at the morning session on April 17, and Will H. Coghill, of the U. S. Bureau of Mines, will present a paper on fine grinding in the Tri-State district.

Labor Relations Directed by Engineers, Lewisohn Says

ENGINEERING executives are taking more and more control of labor relations of big corporations, and bankers and boards of directors have less part in deciding labor policies, declared Sam. A. Lewisohn, vice-president of Miami Copper before the engineering students of Cornell University on March 15. Delivering the Jacob H. Schiff Memorial Foundation lecture, Mr. Lewisohn said:

"The idea that labor policies of corporations are controlled by boards of directors and by New York bankers is also a misapprehension. Many corporations having substantially the same banking connections have radically different labor policies. The men today who have the greatest influence on labor relations policies are the local managers in charge of production, usually engineering executives. Directors are almost helpless in instituting an enlightened labor policy unless the managers in active charge understand and actively believe in it. Very often the directors have the greatest difficulty in persuading the managers to give up a reactionary labor policy. This is because the training of engineers is still in most cases too narrow and does not include the study of human relations upon which industry depends. This is of the utmost importance because more and more the key executive positions in industry are being filled by engineers.

"The popular idea that all there is to the labor problem is the worker's desire for wages is entirely wrong. Exactly the same problems exist in any organization, even where no relations between capital and labor are involved. The labor problem is not merely an economic problem—it is to a large extent an administrative problem. We must add to the 'economic man' of the economists, the 'administrative man.'

"The worker wants three things: justice, opportunity, and status. Justice includes wages and the other economic elements. These are very often beyond the control of the employer because they are in the power of great economic forces outside the factory. Justice also includes sound administration. It is nonsense to think that industry can be successfully run on anything approaching a parliamentary system. The functions of employee committees and works councils should be entirely advisory and consultative. They should enable the management to interpret itself to the men and the men to interpret their aspirations to the management.

"The proportion of workers who really seek advancement is much smaller than commonly believed—it has been estimated not more than 5 per cent. Yet the success of our industrial system is largely dependent upon the training and advancement of the more ambitious minority of workers.

"To make any progress, executives must be free from traditional class feeling and avoid a patriarchal patronizing spirit. Above all, the trading spirit must be avoided. So also must any legalistic attitude. It is particularly dangerous for lawyers to intrude themselves into a situation."

Offer Prizes for Slogans to Promote Electric Heat

Seven prizes, totaling $500, will be awarded by the National Electrical Manufacturers Association and the National Electric Light Association for the best slogans to promote the use of electric heat in industry. Additional information may be obtained by writing to the "N.E.M.A.-N.E.L.A. Slogan Contest," National Electrical Manufacturers Association, 420 Lexington Ave., New York City.

Bureau of Mines to Appoint Chief Metallurgist

The U. S. Civil Service Commission states that the position of chief engineer, metallurgical division, of the U. S. Bureau of Mines, is vacant and that in view of the importance of this position in the field of metallurgical research, the qualifications of candidates will be passed upon by a special board of examiners. The entrance salary is $5,600 a year. Formal applications will be received by the Civil Service Commission until May 8. Full information may be obtained by communicating with the United States Civil Service Commission, Washington, D. C.

Will Resurvey Oregon Mines

The Oregon Legislature in a recent session appropriated $30,000 for resurveying mines in the state. This sum will be matched by the federal government and the work will be directed by the U. S. Geological Survey and started at an early date.

The base of operations in southwestern Oregon will be Grants Pass, and Baker City will be the base in northeastern Oregon. This is the first activity in mine surveying in the state since the Oregon Bureau of Mines was dissolved as a war measure by legislative act in 1916. The recent session of the Oregon Legislature repealed the old-time state law entitling a locator to but one claim on a vein, and the law is now in accordance with the federal code.

Hydraulic Mining Discussed

On March 25, 1929, proponents and opponents of the Sewell bill to aid hydraulic mining in California appeared before the Assembly Ways and Means Committee of the California Legislature. The remnants of the Anti-Débris Association appeared in opposition to the bill, but advanced no new arguments against it. Harold Cloudman, James Stewart, Fred C. Miller, and others spoke in favor, and W. T. Ellis, F. B. Noyes, and others opposed the measure.

MARKET AND FINANCIAL NEWS

Calumet & Arizona Net Income 40 per Cent Higher

NET INCOME of Calumet & Arizona Mining Company amounted to $5,221,640 in 1928, compared with $3,725,596 in 1927, and $3,593,951 in 1926. Profit-and-loss account for the year ended Dec. 31, 1928, is shown in the following table:

Income		
Total earnings on metals	$9,401,727	
Income from dividends	2,523,658	
Interest	165,799	
Other income	333,382	
		$12,424,567
Expenditures		
Operating expenses	$4,788,450	
Salaries, office and general expenses	102,149	
Freight, refining and marketing	1,010,032	
State and federal taxes	676,067	
		6,576,699
		$5,847,868
Less		
Depreciation	$482,208	
Expense at outside properties	144,020	626,228
Net income		$5,221,640

Net current and working assets totaled $8,932,091, according to the balance sheet of Dec. 31, 1928. Current liabilities were $1,011,557.

Production of copper, silver, and gold during 1928 and 1927 compare as follows:

	1928	1927
Gold, oz.	38,507	34,275
Silver, oz.	1,307,768	1,051,809
Copper, lb.	52,368,871	48,812,987

In substance the foregoing totals represent company production but include some metal from purchased ores. The company also sold some ore direct to other plants, the production from which is included in the foregoing table.

President Campbell, in his remarks accompanying the annual report, states that development work in the area tributory to the Cole shaft has disclosed no new orebodies. At the end of the year, tonnage of known ore is slightly larger than normal and geological conditions shown in exploratory openings justify the hope that production of copper can be continued at the present rate and will equal in tonnage the amount produced in the last 25 years.

At the Eighty-Five property near Lordsburg, N. M., the ore reserves are about the same as at the beginning of the year and may serve as a source of siliceous ores for fluxing purposes for several years.

On March 1, 1928, the company renewed its smelting agreement with Shattuck Denn for an additional two years. On June 1, 1928, a pumping agreement was entered into whereby the company will receive all mine water from the Denn mine workings on the 2,200 level. Water was pumped from the Junction mine at the average rate of 2,505 g.p.m. in 1928, compared with 2,627 g.p.m. in 1927. A total of 63,003 ft. of development work was completed during 1928, as against 57,224 ft. in 1927. Of this total, 1,043 ft. was for the joint account of Shattuck Denn Mining Corporation, and Calumet & Arizona Mining.

The average number of employees in all departments at the mines in 1928 was 974, compared with 905 in 1927. The Employees' Benefit Association paid $22,084 in sick, accident, and death benefits. Membership dues and the company's contribution were sufficient to meet all liabilities, and there was a balance on hand, Dec. 31, of $8,731. This balance, together with the balance Dec. 31, 1927, gives the Employees' Benefit Association a surplus of $17,920.

Hecla's 1928 Earnings Higher

DESPITE the lower lead price prevailing in 1928, Hecla Mining Company's operating income for the year was $1,888,042, against $1,575,681 in 1927 and $1,874,535 in 1926. Dividends disbursed amounted to $700,000 in 1928, compared with $1,000,000 in 1927 and $2,000,000 in 1926. Statement of income and expenditures for the year ended Dec. 31, 1928, follows:

Income		
Ore sales—net receipts	$3,399,827	
Interest	32,935	
Rents	35,090	
Miscellaneous	3,541	
		$3,471,394
Expenditures		
Mining and development	$1,037,068	
Crushing, conveying and ore sorting	41,602	
Ore haulage—mine to mill	32,012	
Milling	149,427	
Miscellaneous (general expense, insurance and property taxes)	323,242	$1,583,352
Operating income		$1,888,042
Depreciation reserves		93,792
		$1,794,250
Dividends	$700,000	
Taxes—Federal income and state net profit and miscellaneous adjusting entries	211,266	911,266
Addition to surplus		$882,983
Surplus, Dec. 31, 1927		3,772,624
Surplus, Dec. 31, 1928		$4,655,608

A total of 314,500 tons of ore was treated during the year. Metal production amounted to 59,004,944 lb. of lead and 1,740,082 oz. of silver. The record shows that 6.39 tons of milling ore produced one ton of concentrate in 1928, compared with 6.03:1 in 1927.

James F. McCarthy, the manager of the property, states that the zinc plant under construction by Sullivan Mining Company, owned jointly and equally with Bunker Hill & Sullivan Mining & Concentrating Company, shipped its first product, under the trade name "Bunker Hill" electrolytic zinc, in November. The plant has a monthly capacity of 1,800 tons of slab zinc and is now producing 1,500 tons monthly. Full capacity will be reached at an early date. Ore supplies for the plant came from a stockpile accumulated during the construction period—mostly from the Sidney mine. Production on a small scale has been started from the Star mine of Sullivan Mining Company, which will be increased as the zinc plant is brought to capacity.

Late in the year, a small production—approximately six tons daily—of zinc concentrates from Hecla ores began. These concentrates will go to the Sullivan zinc plant. None had been shipped at the end of the year. With present prices this production should result in additional income of $50,000 annually. During the year the Tiger-Poorman mine was unwatered to the 600 level to determine whether commercial ore existed there. The 300 and 600 levels were explored to their westerly extremity, but no ore was found.

Ore reserves at the end of the year totaled 2,489,497 tons. The 1927 annual report reviewed the development results to the 2,800 level. Work of development from the 2,000 to the 2,800 level has been carried on through a winze, because the main hoisting equipment does not permit hoisting from depths below 2,000 ft. The tonnage disclosed in this work justified the sinking of the main shaft and the purchase of heavier hoisting equipment. The main shaft has been sunk to the 2,800 level and heavier equipment has been ordered and will be in place this year. Following the installation of this equipment the 2,800 level will be connected with the main shaft. The work just outlined should be finished in April or May, 1930.

Southern Rhodesia's Mineral Production Increased in 1928

The total production of minerals in Southern Rhodesia during 1928 was valued at $21,649,246, an increase of $1,023,713 over the record for 1927, according to the U. S. Department of Commerce. The two principal minerals which contributed to the increase were asbestos and coal, the former advancing $857,443 and the latter $471,977. The output of chrome ore decreased in value to $92,223, a result, largely, of the lower prices prevailing. Mica also showed a decrease.

St. Joe Lead Earnings Increased in 1928

DESPITE the lower lead prices prevailing in 1928, earnings of the St. Joseph Lead Company amounted to $4,490,973, compared with $4,027,125 in 1927. The company's mines and mills in St. Francois County, Mo., produced 4,382,138 tons of ore, 202,801 tons of lead concentrates, and 6,584 tons of zinc concentrates. The lead content of the lead concentrates produced was 147,591 tons.

There was produced by Kansas Explorations, Inc., a St. Joe subsidiary, from its properties in the Tri-State district, 422,210 tons of ore, 947 tons of lead concentrates, and 17,119 tons of zinc concentrates. The Edwards mine, in New York State, produced 22,045 tons of zinc concentrates. The company's property at Hughesville, Mont., was equipped with a mill, and started operations in November, lead concentrates being shipped to East Helena and zinc concentrates to Great Falls. This property should produce about 9,000 tons of lead concentrates and about 6,000 tons of zinc concentrates annually.

The Mine La Motte property, in Madison County, Mo., was acquired jointly by the National Lead Company and the St. Joseph Lead Company, and a new company called Mine La Motte Corporation was formed to operate the property. A mill has just been completed, and concentrates will be shipped equally to the National Lead Company's plant at Collinsville, Ill., and the St. Joe smelter at Herculaneum, Mo. Estimated production from this property is 20,000 tons of lead concentrates annually.

The company's exploration department was singularly successful during the last year in finding promising orebodies which should develop into mines.

St. Joseph Lead Company and Subsidiary Companies Consolidated Balance Sheet
Dec. 31, 1928

Assets

Capital assets		
Ore reserves and mineral rights, including appreciation arising from revaluation	$33,525,610.34	
Less reserve for depletion	23,327,099.35	$10,198,510.99
Buildings, plant and equipment	$17,692,828.10	
Less reserve for depreciation	5,892,891.55	11,799,936.55
Railroad property and equipment	$3,743,905.38	
Less reserve for depreciation	726,291.32	3,017,614.06
Exploration expenditures on properties held under option		299,991.94
		$25,316,053.54
Investments		
Investment in and advances to Mine La Motte Corporation (50 per cent owned)	$972,791.61	
Sundry securities and loans	709,958.78	1,682,750.39
Current and working assets		
Inventories at cost:		
Lead and zinc	$1,363,989.23	
Materials and supplies	2,111,630.27	
	$3,475,619.50	
Accounts receivable	1,758,731.61	
Marketable securities and call loans	8,043,374.51	
Cash in banks and on hand	2,586,393.81	15,864,119.43
Deferred charges		
Prepaid insurance, taxes		252,474.22
		$43,115,397.58

Liabilities

Capital stock		
Authorized—2,000,000 shares of $10 each	$20,000,000.00	
Issued—1,996,784 shares	$19,967,840.00	
Less in treasury—46,332 shares	463,320.00	
	$19,504,520.00	
Scrip outstanding	568.50	$19,505,088.50
Minority interest in subsidiary companies		
Capital stock, and proportion of surplus applicable thereto		228,964.25
Purchase money obligations, payable in annual amounts to Sept. 30, 1930		368,750.00
Current liabilities		
Accounts payable	$1,500,570.61	
Wages accrued	108,611.69	
Provision for 1928 federal income tax	596,967.63	
	$2,206,149.93	
Dividends declared, payable quarterly in 1929	5,851,356.00	8,057,505.93
Reserve for contingencies (including federal taxes of prior years)		1,461,502.59
Surplus, per statement attached		13,493,586.31
		$43,115,397.58

Surplus Account

Surplus at Dec. 31, 1927, including surplus arising from revaluation of ore reserves and mineral rights			$14,853,989.89
Profit from operations for the year ended Dec. 31, 1928, after writing off development and exploration expenses on properties abandoned, but before providing for depreciation, depletion and federal income tax		$7,064,526.33	
Add interest, dividends, and miscellaneous income		750,512.65	
		$7,815,038.98	
Deduct provision for:			
Depreciation	$1,050,348.88		
Depletion	1,775,803.27		
Federal income tax	455,623.88	3,281,776.03	
		$4,533,262.95	
Deduct proportion of profit applicable to minority interests		42,289.53	4,490,973.42
			$19,344,963.31
Deduct dividends declared, payable quarterly during 1929			5,851,377.00
Surplus at Dec. 31, 1928			$13,493,586.31

Note—The above surplus comprises:

Surplus as shown by balance sheet of parent company at Dec. 31, 1928	$12,997,192.69	
Accumulated surplus of subsidiary companies, including that arising from revaluation of ore reserves and mineral rights, in excess of surplus reflected on books of parent company	496,393.62	
	$13,493,586.31	

Chinese Antimony Exports to U. S. Higher in 1928

CHINA shipped 7,562 long tons of regulus, 1,395 tons of oxide, and 515 tons of crude antimony to the United States in 1928, compared with 7,031 tons of regulus, 611 of oxide, and 825 of crude the preceding year, according to the U. S. Department of Commerce. The 1928 shipments formed about 71 per cent of the total United States imports of antimony metal, and also represented approximately 54 per cent of Chinese exports and 39 per cent of its total production of that commodity during the year.

Although the cessation of military operations in China during 1928 may have been only a minor influence in the increased output of antimony during the year, it is believed that expanded production in Hunan, maintained in the face of decreased demand from abroad, particularly in the United States, had the effect of depressing prices to Chinese merchants. From the seller's viewpoint, the market was considered unusually dull throughout the year. Production in Hunan at the end of December was estimated at the rate of 1,200 tons monthly; stocks at Changsha on Dec. 31, 1928, were about 2,300 tons and at Hankow they were about 1,600 tons.

No changes were made during 1928 in the export tariff as applied to antimony. Early in the year wages were reduced at the mines and working hours regulated. The rumored scheme of certain Chinese merchants to combine and thus secure control of the market failed to materialize.

COLORADO FUEL & IRON COMPANY reports net income for 1928, before making deductions for equipment dismantled, of $1,010,919. This compares with net income of $2,577,518 in 1927 and $2,748,414 in 1926. Preferred-stock dividends, aggregating $160,000, were continued in 1928. The company reports a decrease of 7 per cent in the volume of steel sales, and a corresponding decrease in coal sales during 1928. The company mined 577,521 gross tons of iron ore in 1928 and purchased 241,186 gross tons.

London Financial News

By W. H. Doman
Special London Correspondent

London, March 19, 1929. — At the annual meeting of shareholders of the British Metal Corporation last week, C. V. Sale, the chairman, said that taken as a group, non-ferrous metals may still be regarded as standing at a moderate level, adding "we should perhaps make an exception as regards copper, in which an outstanding advance has been registered; the rise has recently been very rapid, and, so far as one can judge, has gone too far. It is never possible to appraise consumption exactly, but such estimates as we can make show very little excess of consumption over current output, and we think stocks in the hands of manufacturers are substantially greater than a year ago." Since then prices have risen still further, and for the movement in copper it is not easy to find an explanation. From inquiries I have made, it would almost appear that someone has been caught short. The representative of one large firm of dealers informed me, with a smile, that there were bears about. Another said that the British Metal Corporation had caught some one bending. The B.M.C. is in as good a position as anyone to tell where stocks have gone, and what consumption may be, but it does not know exactly. Another firm suggested that the metal was being bought for America, but that it was not going into consumption. Yesterday the price jumped about £7 per ton to £97 10s. and now stands at £94 2s. 6d. This compares with an average of £55 13s. 10d. for 1927, a highest and lowest of last year of £74 15s. and £60 2s. 6d. and with £74 15s. on Jan. 1, 1929.

The rise in metal prices has naturally brought old properties to the front again. One of them, the Lake George, near Canberra, has, I hear, been bought by R. Tilden Smith, of the National Metals & Chemical Bank, as an investment on his own account, and he is said to have leased it to Camp Bird. Rhodesian coppers are rising, and Rhodesia Congo Border is now quoted at £7¾.

For the first time in several years, lead at £31 10s. is quoted above the price of spelter, which is £29 3s. 6d. Someone suggested that this is due to the revolution in Mexico, and that bears have been caught. Tin also has risen, and is now £224 2s. 6d. per ton.

Some weeks ago, Hugh F. Marriott, who has been elected a director of Panama Corporation, visited the property. He represents, I believe, a certain amount of capital put into the undertaking and went to assure himself of the position. He has just cabled that he is leaving for home on Saturday next, and that he is thoroughly satisfied with his visit.

Shareholders in Shamva Mines have received a nasty shock. Owing to unsatisfactory developments, Dr. Malcolm Maclaren was commissioned to visit the mine. It was thought that the orebodies were pitching westward, but developments in the deeper workings of the No. 10 level have shown this view to be erroneous, in all probability, and that the shoots are pitching in an easterly direction. An internal shaft is to be sunk to a depth of 200 ft. Two years' further life are indicated.

British Board of Trade Loses on Australian Zinc

The auditor-general of Australia reports that the loss of the British Board of Trade on purchases of Australian zinc concentrates for the year ended March 31, 1928, was £973,000, which increased the cumulative loss since 1918 to £4,667,000. Allowing for £1,258,000 received in interest on advances, and £750,000 placed to reserve, the net loss for the ten years averaged 28s. 6d. per ton of concentrates. The contract was for 300,000 tons of zinc concentrates per annum at a price equivalent of about £28 per ton of slab zinc. It expires next year.

Imports and Exports of Ores and Metals in February, 1928 and 1929

Compiled from U. S. Department of Commerce Records

In Pounds, Unless Otherwise Stated

Imports

	February 1928	February 1929
Antimony		
Ore—Gross weight	889,187	1,001,006
—Antimony content	485,416	565,988
Copper		
Ores, copper content	6,975,205	7,314,448
Concentrates, copper content	4,151,227	2,921,692
Regulus, coarse metal, cement copper	265,168	110,000
Imported from		
Spain	758,386	401,592
Canada	2,367,997	6,514,513
Mexico	4,304,787	2,527,144
Cuba	1,080,000	7,254
Chile	2,721,823	667,773
Peru	77,673	152,864
Other countries	80,934	25,000
Unrefined black, converter copper in pigs, bars and other forms	41,256,223	40,703,261
Refined copper	561,782	19,532,456
Old and clippings for remanufacture	894,564	650,463
Composition metal, copper chief value	6,720	.....
Brass, old, for remanufacture	648,384	880,144
Lead		
Ore and matte, lead content	3,653,290	3,839,358
Bullion or base bullion	13,495,552	15,241,488
Pigs and bars	149	19,821
Babbitt, solder and other forms — Lead content	201,610	125,426
Babbitt, solder and other forms — Gross weight	86,874	54,989
Type metal, antimonial lead — Gross weight	327,207	.....
Type metal, antimonial lead — Lead content	264,557	.....
Manganese, tons		
Cuba, manganese content	123	110
Other countries, manganese content	18,215	20,710
Pyrites, tons	44,535	13,826
Tin, ore, tons	2	7
Bars, blocks, pigs	13,422,056	16,407,473
Imported from		
Netherlands	1,433,831	1,075,802
United Kingdom	1,298,000	2,611,987
British Malaya	9,623,335	10,770,055
Netherlands East Indies	11,186	21,300
Hongkong	697,086	1,481,225
Australia	123,200	156,861
Other countries	235,418	290,243
Zinc		
Ore, zinc content — Free, less than 10 per cent zinc	.....	.....
Ore, zinc content — Dutiable	204,000	5,789,080
Blocks, pigs and other forms, old	100	100

Exports

	February 1928	February 1929
Copper		
Ores, composition, concentrates, unrefined	574,959	47,893
Refined copper in ingots and other forms	73,061,047	80,339,488
Exported to		
Belgium	9,264,117	5,997,364
France	9,206,049	17,277,180
Germany	23,523,818	19,610,493
Italy	4,619,409	7,569,453
Netherlands	5,934,150	4,412,943
Spain	.....	818,081
Sweden	2,574,445	2,495,079
United Kingdom	16,009,121	19,253,638
Other Europe	1,092,074	326,414
Canada	111,584	1,923,518
British India	56,000	280,000
China, Hongkong and Kwantung	134,400	.....
Japan	448,025	224,279
Other countries	87,855	151,046
Old and scrap	4,479,113	5,236,612
Pipes and tubes	436,683	350,834
Plates and sheets	472,982	811,944
Rods	6,633,243	10,771,543
Insulated copper wire and cable	1,493,902	2,703,528
Lead		
In pigs, bars and other forms	16,048,549	13,882,612
From domestic ore	169,569	7,897,172
From foreign ore	15,878,980	5,985,440
Exported to		
France	1,232,334	224,057
Germany	5,623,906	6,430,402
Netherlands	952,206	515,327
Sweden	568,641	1,468,018
United Kingdom	3,360,913	1,288,367
Other Europe	728,256	728,147
Brazil	448,007	224,066
Other South America	521,293	902,051
China, Hongkong, Kwantung	336,225	.....
Japan	2,073,279	1,905,362
Other countries	203,489	196,815
Other lead manufactures	963,939	1,221,162
Zinc		
Ores and concentrates, tons	112	.....
Dross	1,539,634	330,482
Cast in slabs, blocks and pigs	4,250,498	2,362,527
Exported to		
Belgium	112,006	45,781
France	448,173	448,085
Germany	1,299,288	582,442
Italy	291,334	.....
Netherlands	179,183	.....
United Kingdom	470,525	358,447
Other Europe	325,087	224,244
Japan	896,096	672,019
Other countries	228,806	31,509
Sheets and strips, other forms	713,872	696,306
Dust	213,178	135,129
Other zinc manufactures	50,701	85,166

The Market Report

Metal Markets Exceedingly Dull

New York, April 3, 1929—Metal sales have exhibited a marked slump in the week ending today, though the lack of demand has had little or no adverse effect on prices. The break in the stock market is generally held accountable for the pronounced let-up in activity, with the Easter holidays a contributing factor.

Copper Still 24c., Delivered

A small amount of copper was marketed today by two different sellers at 24c., delivered Connecticut, thus maintaining the price at the peak figure recently reached in the current movement, though for the first time for months there has been no general effort to buy on the part of consumers, and it is probable that more could have been accommodated. Producers seem perfectly willing to remain out of the market for a month or two and are hoping that the demand will be sufficient to absorb the offerings of the custom smelters and prevent a price recession. Such a recession, they hold, if severe, would inure to the disadvantage of consumers by bringing about a cancellation of orders for manufactured material. Some resale lots of small magnitude offered at 23½@23¾c. have been quickly absorbed. The foreign market continues at 24⅛c., but sales so far in April have been almost non-existent.

Average Metal Prices for March, 1929

COPPER:	
New York Electrolytic	21.257
London Standard Spot	89.153
London Electrolytic Spot	98.356
LEAD:	
New York	7.450
St. Louis	7.348
London Spot	25.409
London Forward	25.591
SILVER:	
New York	56.346
London	26.000
Sterling Exchange	484.776
ZINC:	
St. Louis	6.463
London Spot	27.050
London Forward	27.294
TIN:	
Straits	48.870
London	220.781
QUICKSILVER	121.904
ANTIMONY	9.531
PLATINUM:	
Refined	70.000
Crude	60.000
ALUMINUM 99 Per Cent Plus	24.300

Daily Prices of Metals

March April	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
28	23.775	48.75	7.75	7.65@7.70	6.70@6 80
29	23.775	48.75	7.75	7.65@7.70	6.75
30	23.775	48.75	7.75	7.65@7.70	6.75
1	23.775	48.75	7.75	7.65	6.80
2	23.775	48.625	7.75	7.65	6.80
3	23.775	48.50	7.75	7.65	6.80
	23.775	48.688	7.750	7.663	6.775

Average prices for calendar week ending March 30, 1929, are: Copper, 23.775; Straits tin, 48.771; N. Y. lead, 7.775; St. Louis lead, 7.677; zinc, 6.704; and silver, 56.313.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis; that is, delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted.

Quotations for copper are for the ordinary form of wire bars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

March April	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
28	94	95⅜	110	220¼	221⅓	26 5/16	26 5/16	27½	27½
29	Holiday	...	...	...	...	...	...	...	...
1	Holiday	...	...	...	...	...	...	...	...
2	95¼	95⅜	110	219½	220⅜	26⅜	26⅜	27 9/16	27 9/16
3	95⅞	96 1/16	108	219½	220⅜	26 11/16	26⅝	27 11/16	27 9/16

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

March	Sterling Exchange "Checks"	Silver		Gold London	April	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
28	4.84¾	56½	25 15/16	84s11½d	1	4.84 11/16	56½	Holiday	Holiday
29	4.84 11/16	56½	Holiday	Holiday	2	4.84⅝	56⅜	25 13/16	84s11½d
30	4.84⅝	56½	Holiday	Holiday	3	4.84 11/16	56	25⅞	84s10¾

Average, 56.188

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command five-eighths cent premium.

Lead Quiet but Firm at 7¾c.

A marked slackening in the demand for lead during the last week may be attributed primarily to the unsettled condition of the stock market, though weakness in lead quotations on the London Metal Exchange served to dampen the buying ardor somewhat, also. In the aggregate, the total of sales recorded amounts to approximately 75 per cent of average. A considerable proportion of the week's sales total changed hands on Monday and Tuesday, when the larger producers first opened their books for May positions.

Enhanced production undoubtedly will soon be noticeable as a result of the prevailing prices, but if shipments from Mexico are interfered with to any marked extent a considerable increase in production will be needed to fulfill large domestic requirements.

Zinc Firm at 6.80c.

Zinc has been as quiet as copper, but the price seems to have advanced to a firm quotation at 6.80c., St. Louis, in view of the improved ore market at Joplin. For the time being, producers seem content to wait for the demand.

Tin Slightly Weaker

Though consuming demand in good volume was prominent in the tin market on one or two days of the past week, a slight downward trend of prices for the metal has been noticeable. A moderate tonnage of Cornish 99 per cent tin changed hands in the domestic market during the last week at about 1c. per pound below the price of Straits tin.

Silver Dull and Lower

Because of the Easter holidays, the silver market has been very dull during the past week. London opened unchanged on Tuesday, but prices in New York were easier. Chinese selling caused a small decline in London today, which was reflected in this market, the price of 56c. here being the lowest since Feb. 23. The close was quiet and fairly steady.

Mexican Dollars (Old Mexican pesos): March 28th, 29th, 30th, and April 1st, 42½c.; 2d, 42⅜c.; 3d, 42¼c.

Foreign Exchange

Closing cable quotations on Tuesday, April 2, 1929, were as follows: Francs, 3.90$\frac{31}{32}$c.; lire, 5.23$\frac{7}{16}$c.; and marks, 23.71⅛c. Canadian dollars ¾ of 1 per cent discount.

Zinc Concentrates Higher; Lead Unchanged

Joplin, Mo., March 30, 1929

Blende

	Per Ton
High	$46.00
Premium blende, basis 60 per cent zinc	$44.00@ 45.00
Prime Western, basis 60 per cent zinc	43.00@ 44.00
Table concentrates, basis 60 per cent zinc	41.00@ 43.00
Flotation concentrates, 60 per cent zinc	40.00@ 41.00
Average settling price, all zinc	42.53

Galena

High	$108.80
Basis 80 per cent lead	105.00
Average settling price, all lead	103.00

Shipments for the week: Blende, 15,080; lead, 3,177 tons. Value, all concentrates the week, $968,590.

Shipments were approximately 5,000 tons less than the purchase made last week for this week's shipment; a light drizzling rain, falling daily until today, retarded loading. Zinc concentrate prices were again advanced $1.50 per ton on all grades, an increase of $3 in two weeks. Buying orders were less this week and sellers were inclined to sell slow even on the advance offered, with the result that approximately 4,000 tons less concentrate was contracted than last week.

Buyers continue to report the open market for lead ore $105 per ton, basis of 80 per cent lead, but settlements reported indicate that either a higher basis was paid or some form of premium was offered.

Platteville, Wis., March 30, 1929

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$46.75
Lead Ore	
Lead, basis 80 per cent	$105.00

Shipments for the week: Blende, 703 tons; lead, 40 tons. Shipments for the year: Blende, 8,690; lead, 440 tons. Shipments for the week to separating plants, 1,059 tons blende.

Steel Production at Peak

Pittsburgh, April 2, 1929

Compared with usual seasonal variation, there was a bulge in steel production beginning about July 1 last, and in the first quarter of this year there has been a further bulge, the quarter's total being fully 10 per cent above that of a year previous, although the 1927 mark was a record high by a small margin. There is corresponding uncertainty as to the continuance of the rate. Automobile production in the last three months has run 25 per cent above normal expectancy based on the previous rate of gain with allowance for seasonal variation, and may therefore have a sharper drop than usual.

Pig Iron—Valley furnaces have marked up their asking prices 50c., but the higher prices have not been well tested, demand being light. Bessemer and malleable, $18.50; basic and foundry, $18, f.o.b. furnaces, freight to Pittsburgh being $1.76.

Connellsville Coke—The market has lost about half the advance it scored in February on furnace grade, now quotable at $2.85@$3.00 for spot, but spot foundry has stiffened, being now $4@$4.50. Some furnaces refrained from contracting for second quarter on account of higher prices, and bought April deliveries only.

Other Metals

Quotations cover large wholesale lots, f.o.b. New York, unless otherwise specified. London prices are according to latest mail advices.

ALUMINUM—Per lb., 99 per cent plus grades, price of leading interest, 24.30c. Outside market, 99 per cent plus, 24.30c.; 98-99 per cent, 23.90c. London, 98 per cent, quoted at £95 per long ton, less 2 per cent for domestic consumption.

ANTIMONY—Per lb., duty paid: Chinese brands, for all positions, 9⅛@9¼c. Cookson's "C" grade, spot, 14½c. Chinese needle, lump, 8c. Standard powdered needle, 200 mesh, 10c. Nominal.

BISMUTH—Per lb., in ton lots, $1.70. Smaller lots $1.85 and up. London 7s. 6d.

CADMIUM—Per lb.. 85@95c. Active. London, 4s.@4s. 2d. for Australian metal, early delivery.

CHROMIUM—Per lb., 97 per cent grade, $1.50.

COBALT—Per lb., f.o.b. Canadian works: Shot, 96@98 per cent, $2.10@$3. Black oxide, 70 per cent, $2.10. London, 10s. for metal in small lots, 8s. for black oxide; 8s. 10d. for gray. Market somewhat more active.

[1]GERMANIUM OXIDE—Per gram in 300- to 500-gram lots, $3.50.

IRIDIUM—Per oz., $260@$265 for 98@99 per cent sponge and powder. London, £57@£60.

[1]LITHIUM—Per oz., 98@99 per cent grade in 1- to 5-lb. lots, $5.

MAGNESIUM—Per lb., in ton lots, single orders for spot metal: 8-lb. ingots (3x3x15 or 16 in.), 85c.@$1.05, depending on quantity; 2½- or 3-lb. sticks (1⅛ in.), $0.90@$1.10, depending on quantity; 10-oz. sticks (1x12 in.), 85@90c. Discounts up to 20 per cent on larger orders or contracts. Market active. London 3s. 3d.@3s. 9d. for 99 per cent ingots or sticks.

[1]MOLYBDENUM—Per lb. in 1- to 3-lb. lots, 99 per cent, $18. (Usually sold as calcium molybdate or ferromolybdenum, which see).

NICKEL—Per lb., ingot 35c.; shot 36c.; electrolytic, 35c. (99.90 per cent), for single lots of spot metal. London, per long ton, £170@£175 according to quantity.

OSMIUM—Per oz., $58@$65; London, £12@£14.

PALLADIUM—Per oz., $38@$40. London, £9 10s.@£10 10s.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, per oz., $70. Transactions between dealers and refiners in the outside market are commonly reported at several dollars less.

London, per oz., £13 17½s., for refined; crude and scrap, nominal at £13@£13½.

QUICKSILVER—Per 76-lb. flask, $122. Small lots command the usual premium. San Francisco wires $123 for retail and small wholesale lots. London quiet, with offers of spot at £22 2½s.@£22 5s.

RADIUM—Per mg. radium content, $70.

RHODIUM—Per oz., $45@55. Nominal. London, £11@£12.

RUTHENIUM—Per oz., $45@$55. Nominal. London, £9@£10.

[1]SELENIUM—Per lb. in ton lots: Black, powdered, amorphous, 99.5 per cent pure, $2.25. London, 7s. 8d.@7s. 9d.

TANTALUM—Per gram: Bar and heavy sheet, chemically pure, 20c.; tantalum powder, 11c.

TELLURIUM—Per oz., 15@18c.

THALLIUM METAL—$12.50@$15 per pound.

TITANIUM—Per lb., 80@90 per cent grade, $5.

TUNGSTEN POWDER—Containing 97 to 98 per cent tungsten, per lb., $1.20@$1.35, depending on quantity. Nominal.

VANADIUM—Per gram, 92@95 per cent grade, $1.25.

[1]ZIRCONIUM METAL—Per oz., 98 per cent grade, $1.56 in 5- to 10-lb. lots.

Metallic Ores

ANTIMONY ORE—Bolivian ore, 60 per cent metallic antimony, $1.30 per short ton unit, c.i.f. New York.

CHROME ORE—Per long ton, f.o.b. Eastern shipping points, Indian and Rhodesian ores, $22 for 47 per cent Cr_2O_3 ore to $23.50 for 50@51 per cent ore. New Caledonian ore, high-grade, $25.

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[1]Price furnished by Foote Mineral Co., Philadelphia.

IRON ORE—Per long ton, lower Lake ports. Lake Superior ores:

Mesabi, non-bessemer, 51½ per cent iron, $4.50. Old Range, non-bessemer, $4.50.

Mesabi, bessemer, 51½ per cent iron, $4.65. Old Range, bessemer, 51½ per cent, $4.80.

Eastern ores, cents per unit, delivered at furnaces: Foundry and basic, 56 to 63 per cent, 8c.

Foreign ores, f.o.b. cars Atlantic ports, cents per unit:

North African, low-phosphorus, 11½ @11¾c.

Spanish and North African basic, 50@60 per cent, 10@11c. Nominal.

Swedish foundry or basic, 66@68 per cent, 9@10c.

Newfoundland foundry, 55 per cent, 8½@9c.

MANGANESE ORE—Per long-ton unit of Mn, c.i.f. North Atlantic ports. Exclusive of duty. Brazilian and Indian ores, minimum 47 per cent Mn, 30@32c. Caucasian (washed), 53@55 per cent, 36@38c. Market easy.

Per ton in carload lots:

[1]Chemical grades, powdered, coarse or fine, 82@87 per cent MnO_2. Brazilian and Cuban, $70@$80. Caucasian, minimum 85 per cent, $70. Montana, 70 to 75 per cent, $70@$80. Domestic, 70 to 72 per cent, $40@$50.

TANTALUM ORE—Per unit of Ta_2O_5, basis 60 per cent ore, $13.

TITANIUM ORE—Ilmenite, per gross ton, 50 per cent TiO_2, f.o.b. Atlantic seaboard, $9.50@$11, according to grade and impurities. Low-grade domestic, 32 to 35 per cent, about $7@$8 per gross ton. Rutile, per lb., guaranteed minimum 94 per cent concentrate, 10c. in carload lots.

TUNGSTEN ORE—Per short-ton unit of WO_3, N. Y.: Wolframite, $14@$15. Nominal quotation, as the increased rate of consumption has brought about what appears to be a general world shortage. Good demand, and ore for near-by deliveries could demand almost any price in reason. Western sheelite, $15. Market firm and stocks very low.

VANADIUM ORE—Per lb. V_2O_5 contained, 28c.

ZIRCON ORE—Per net ton containing 55 per cent ZrO_2, f.o.b. Atlantic seaboard, $40@$45 in 30-ton lots.

Non-Metallic Minerals

Prices received for non-metallic minerals vary widely and depend upon the physical and chemical characteristics of the commodity. Hence the following quotations can serve only as a general guide to the prices obtained by producers and dealers in different parts of the United States for their own product. In the last analysis the value of a particular non-metallic mineral can be ascertained only by direct negotiation between buyer and seller.

[1]AMBLYGONITE—Per ton, f.o.b. mines: 8@9 per cent lithium oxide, $50@$60.

ASBESTOS — Per ton: f.o.b. Quebec mines, tax and bags included, prices quoted by leading interest for delivery on 1929 contract:

Crude No. 1, $550@$750; crude No. 2, $450@$575; spinning fibers, $225@$275; magnesia and compressed sheet fibers, $175@$225; shingle stock, $55@$115, various grades; paper stock, $45@$50; cement stock, $25; short fibers, $10@$20; floats, $12@$15. Europe reports a general shortage of Canadian spinning fiber and No. 2 crude.

Per ton c.i.f. New York: Rhodesian crude No. 1, $450; No. 2, $350.

BARYTES—Per ton: f.o.b. mines, bags extra:

Georgia: Barytes ore, crude (per long ton), $6.50. Washed and water floated to 97 per cent through 300 mesh, $19. Shipments steady and contract quotas being absorbed.

Missouri: Water ground and floated, bleached, $23; $25 in less than car lots, f.o.b. works. Crude ore, 93 per cent $BaSO_4$, not to exceed 1 per cent iron, $7@$7.25 f.o.b. mines. Market steady.

BAUXITE—Per long ton: Domestic ore, chemical, crushed and dried, 55 to 58 per cent Al_2O_3, 1.5 to 2.5 per cent Fe_2O_3, $7.50@$8.25 f.o.b. *Alabama* and *Arkansas* mines. Other grades, 56 to 59 per cent Al_2O_3, 5 to 8 per cent SiO_2, $6.75@$8.25 f.o.b. *Arkansas* mines. Pulverized and dried, $12@$14 f.o.b. *Arkansas* mines; calcined, 78 to 84 per cent Al_2O_3, $18@$20 f.o.b. *Arkansas* mines. Market quiet pending outcome of tariff legislation contemplating abrogation of bauxite tariff.

Per metric ton, foreign c.i.f. Atlantic port: Dalmatian, 50 to 55 per cent Al_2O_3, 1 to 3 per cent SiO_2, $4.50@$6.50; Istrian, 54 to 57 per cent Al_2O_3, 3 to 5 per cent SiO_2, $5.50@$7; French, 56 to 59 per cent Al_2O_3, 2 to 5 per cent SiO_2, $6@$8.

BORAX—Per lb.: Carload lots, in bags, crystals, 2¼c.; granulated or powdered, 2½c.; f.o.b. consumers' shipping point. Market fair.

[1]CELESTITE—Per ton in carload lots: 90 per cent $SrSO_4$, finely powdered, $27.

CHALK—Per ton: Crude in bulk, c.i.f. *New York*, $4.75@$5.

CHINA CLAY (KAOLIN)—Per ton: F.o.b. *Virginia* mines, crude lump, No. 1, $7; crude No. 2, $5.50; washed, $8; powdered and air-floated, $8@$15; ground, $7@$15.

Florida, pressed pottery, bulk, $13; ground, No. 1, $20; No. 2, $15. Sprayed mineral flour in 100-lb. bags (bags extra), No. 1, $20; No. 2, $17. Market quiet.

Best grade, domestic, $16@$18, f.o.b. *Delaware* plants in carload lots. Market slow.

Imported English, f.o.b. American ports: Lump, $13@$21; powdered, $40@$45.

DIATOMITE—Per short ton, f.o.b. producing plant:

Kiln-fired brick, $65; kiln-fired aggregate, ¼ in., $45; insulating powder, $25; natural aggregate, ¼ in., $18@$20; air-floated powder, $45; 80 to 85 per cent silica, 98 per cent through 200 mesh, $20 in carload lots.

EMERY—F.o.b. *Pennsylvania* and *New York* in 350-lb. kegs, per lb.: Greek Naxos, 6½c.; Turkish, 6½c.; Khasia, 6½c.; domestic, 3½c.

FELDSPAR—F.o.b. mine or grinding plant:

North Carolina, per long ton, No. 1 pottery grade, crude, $6.50@$7.50; glass grades, $5@$6. Market fair for No. 1 grade, dull for No. 2.

No. 1, pottery, 140 mesh, $16; 200 mesh, $18. No. 2, enamel, 20 mesh, $10.25; 90 mesh, $12; 140 mesh, $13.75; 200 mesh, $15.50. No. 3, 20 mesh, $9. Market good.

New Hampshire, per ton: Pottery grade, $8. Best quality lump, $9.

New York, per ton: f.o.b. cars, No. 1 crude, $9. Market fair.

Maine, per ton: Best pottery grade, ground, $19. Market fair.

FLUORSPAR — Per ton: F.o.b. *Kentucky* and *Illinois* mines:

Gravel, not less than 85 per cent CaF_2, and not over 5 per cent SiO_2, $18. Foundry lump, 85-5, $20. Ground, 95 to 98 per cent CaF_2, and not over 2½ per cent SiO_2, $32.50 in bulk; $36.50 in bags or barrels. Acid lump, 98-1, $32.50 in car lots. Market firm. Improvement in demand is expected later in the season.

New Mexico: 85-5 gravel, $15.85; 85-5 lump, $16.50; 94-3 lump, $22; 96-3 100-mesh, $30. Market good.

Foreign spar, duty paid, $19.40, tidewater.

FULLER'S EARTH — Per ton, f.o.b. *Florida:* 16 to 30 mesh, $16.50; 30 to 60 mesh, $18; 16 to 60 mesh, $17; 60 to 90 mesh, $14; 100 mesh up, $7. Market good.

Powdered, import duty paid, $24@$25 per ton.

GARNET—Per ton; domestic, f.o.b. mines, $85.

Spanish grades, $60, c.i.f. port of entry.

GILSONITE — Per ton, carload lots, f.o.b. mines *Colorado*.

Selected grade, $33; seconds (mine run), $25.50.

GRAPHITE—Per lb., f.o.b. *New York:* Ceylon lump, 7¾@8¾c.; chip, 6½@7½c.; dust, 3@5½c.; Madagascar flake, 6½@7c. Market fair.

No. 1 flake, 8c. and up. No. 2 flake, 6c. and up. Foundry facings, 3c. and up. Graphite facings, 4c. and up. Amorphous and crystalline, fine ground, 3c. and up. Market highly competitive.

Crude amorphous graphite, $15@$35 per ton, according to grade.

GREENSAND—Per ton, f.o.b. cars, *New Jersey:* Screened and bagged, best grade in carload lots, $20. Market improving.

GYPSUM—Per ton, f.o.b. mill, depending upon location: Crushed, $1.70@$6; ground, $4@$9; agricultural, $4@$9; calcined, $4@$13.

IRON OXIDE (See Ocher)—Per lb.: Standard Spanish red, 3@4½c.; domestic earth, 2@4½c.

KAOLIN—See China Clay.

[1]LEPIDOLITE—Per ton: $20@$30 for ordinary grades. Nominal.

LIMESTONE—Per ton: f.o.b. shipping points, depending on location, either lump or crushed, 25c.@$3.

Agricultural, 40c. up to $5 for crushed or pulverized. Prices depend upon source, purity, and fineness.

MAGNESITE — Per short ton, f.o.b. *California* mines: Grade "A" calcined, 80 per cent through 200 mesh, $43; Grade B, $40; dead burned, $29; crude, $11. *Washington:* Dead-burned magnesite, $22@$24 per net ton, Chewelah, Wash.

MICA—Per ton, f.o.b. plant:

New Hampshire: Mine run, $250; clean shop scrap, $25; roofing, $25. White dry ground, 20 mesh, $28; 40 mesh, $38; 60 mesh, white, $55; off-color, $34; 100 mesh, $70; 200 mesh, $80. Granite mica facings for cement block and stucco use, $8@$12, depending on size between ¼ in. and 60 mesh. Prices higher and market stronger, discussion of a tariff increase being heard.

North Carolina: White, ground, 20 mesh, $35; 70 mesh, $100.

Madagascar, amber, per lb., f.o.b. *New York,* duty paid: No. A1, $2.50; No. 1, $2; No. 2, $1.65; No. 3, $1.15; No. 4, 60c.; No. 5, 45c.

[1]MONAZITE—Per ton: (Minimum 6 per cent ThO_2), $130.

OCHER — F.o.b. *Georgia* mines, per ton: $19@$20 in sacks; $21@$22 in barrels; washed and water floated, $18; second grade, 99 per cent through 225 mesh, $18. Market good.

PHOSPHATE—Per long ton, f.a.s. or f.o.b. mines:

Florida, pebble, f.a.s., for export: 76@77 per cent, $7; 75 per cent, $6.25; 74@75 per cent, $6; 70 per cent, $4.50; 68 per cent, $4.10. Prices firm.

Florida, pebble, domestic: 76@77 per cent, $6.50; 74@75 per cent, $5.50; 72 per cent, $4.50; 70 per cent, $4.

Tennessee, ground, 90 per cent through 200 mesh, 33 per cent P_2O_5, $11.20 per short ton. Brown lump for acid manufacture, per gross ton, $6 on 75 per cent basis; $5.25 on 72 per cent basis. Non-acidulated, fine ground, 65 per cent, $8 (per short ton).

POTASH—The ruling contract prices are as follows:

	Bags	Bulk
Muriate of potash 80 @ 85 per cent, basis 80 per cent.....	36.40	34.80
Sulphate of potash 90 @ 95 per cent, basis 90 per cent..	47.30	45.70
Sulphate of potash-magnesia 48 @ 53 per cent, basis 48 per cent	27.25	25.65
Manure salt 30 per cent.....	21.75	18.75
Manure salt 20 per cent.....	15.40	12.40
Kainit 14 @ 16 per cent.....	12.50	9.50
Kainit, 12.4 per cent.....	12.00	9.00

Two thousand pounds net weight, c.i.f. Atlantic and Gulf ports. German weights, tares and analyses.

PUMICE STONE—Per lb.: In barrels, powdered, 2½@4c.; selected lump, 5@7c.

PYRITES—Per long ton unit of sulphur: C.i.f. United States ports; guaranteed 48 per cent sulphur: Spanish, 13c.; Tharsis, furnace size, 2½ in. diameter, 14c. Cinder from ore to remain property of buyers.

[1]QUARTZ ROCK CRYSTALS—Per lb. in ton lots: Colorless, clear but flawed, pieces ¼ to ½ lb. in weight, 20c. For optical purposes, four times above price; larger crystals still higher.

SILICA—Per ton: Water ground and floated, in bags, f.o.b. Illinois: 400 mesh, $31; 350 mesh, $26; 250 mesh, $18. Market fair. Glass sand, f.o.b. producing plant, 75c.@$5 per ton; molding sand, 65c.@$3.50; blast sand, $1.35@$3.50.

[1]SPODUMENE — Per ton: $20@$30, depending upon lithium content. Nominal.

SULPHUR—Per long ton for domestic market, $18 f.o.b. Texas mines; $22 for export, Atlantic ports. Prices in reality are on a c.i.f. basis, but the average price reduced to an f.a.s. figure is about as given. Open prices $1 to $3 higher than above.

TALC—Per ton, carload lots, f.o.b. works, containers included:

Vermont: 99 per cent through 200 mesh, extra white, $9@$9.50; 97½ to 98½ per cent through 200 mesh, medium white, $8.50@$9; packed in 50-lb. paper bags; prices $1 per ton less in burlap sacks plus 15c. net for bags packed 12 to the ton. Market weak. Prices disturbed by severe competition.

New York: Double air-floated, short fiber, 200 mesh, $13.75; 325 mesh, $14.75. Market fair.

Georgia: Powdered, gray, $7.50@$10; yellow, $9@$12; red, $11@$13; roofing, $7.50@$9.

New Jersey: Soapstone, ground, $10@$12.

TRIPOLI—Per short ton, burlap bags, paper liners, minimum carload 30 tons, f.o.b. *Missouri:* Once ground through 40 mesh; rose and cream colored, $14. Double ground through 110 mesh; rose and cream, $17. Air-floated through 200 mesh, rose and cream, $25; mill run, $15. Usual spring business.

Metallic Compounds

ANTIMONY OXIDE—White, Chinese, 99 per cent Sb_2O_3, 14½c. per lb. Nominal.

ARSENIOUS OXIDE (White arsenic)—Per lb., 4c.; delivered near by. Market firm. London, per long ton, £16@£16¼ quoted for Cornish white: Mexican high grade, £17, c.i.f. Liverpool.

CALCIUM MOLYBDATE OR MOLYTE — Per lb. of contained Mo, 95c., delivered.

COPPER SULPHATE (Blue Vitriol)—Per lb. in car lots, 7c., for either large or small crystals.

SODIUM NITRATE—Per 100 lb.; crude natural, in bags ex vessel, Atlantic ports, $2.22½ for all positions.

SODIUM SULPHATE (Salt Cake)—Per ton, bags, f.o.b. works, $20; in barrels, $24@$33.

ZINC OXIDE—Per lb. in bags, in car lots: Lead-free, 6½c.; 10, 20 or 35 per cent leaded grades, 6⅝c.; French red seal, in bags, 9⅜c.

[1]Price furnished by Foote Mineral Co., Philadelphia.

Alloys

[1]FERROCERIUM—Per lb., $7 in 15 to 75 lb. lots.

FERROCHROME—Per lb. of contained chromium, 60@70 per cent chromium, 4 to 6 per cent carbon, 11c. Freight allowed in carload lots east of Mississippi River and north of Baltimore.

FERROMANGANESE — Per gross ton furnace: Domestic and foreign, 78@82 per cent, $105. Spiegeleisen, 19@21 per cent, $33@$34 on carload business, f.o.b. furnace.

FERROMOLYBDENUM—Per lb. of Mo, f.o.b. shipping point, 50@60 per cent Mo, $1.20.

FERROPHOSPHORUS—Per ton, 18 per cent P, $91; electrolytic, 24 per cent, $122.50; f.o.b. *Alabama* and *Tennessee.*

FERROSILICON—Per gross ton, f.o.b. works, freight allowed on carload lots east of Mississippi River and north of Baltimore: 50 per cent, $83.50; 75 per cent, $130; 15@17 per cent, $45, f.o.b. Suspension Bridge, N. Y. Quotations for spot shipments $5@$10 per ton higher on 50 and 75 per cent grades.

FERROCARBONTITANIUM — Per ton: $160, f.o.b. producer's plant.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent W, $1.25, f.o.b. works. Market active. Some market factors feel that the tungsten ore shortage is caused by speculative anticipation of a tariff increase.

FERROVANADIUM—Per lb. of V contained, f.o.b. works, freight allowed, $3.15@$3.50, depending on grade and quantity.

NICKEL SILVER—Per lb. for 18 per cent nickel Grade A sheets, 37¼c.

YELLOW (MUNTZ) METAL—Dimension sheets, per lb., 28¾c.; rods per lb., 25¾c.

Rolled Metals

COPPER—Sheets, hot-rolled, per lb., 33¾c.; wire, per lb., f.o.b. mill, 25⅞c.

LEAD SHEETS—Full rolled, 11½c. per lb.; clipped, 11¾c.

MONEL METAL—Per lb., sheets, full finished, 42c.; rods, hot-rolled, 35c.

NICKEL—Per lb., sheets, full finished, 52c.; rods, hot-rolled, 45c.

ZINC SHEETS — Per lb., 10c., f.o.b. works.

Refractories

CHROME BRICK—Per net ton, f.o.b. shipping point, $45.

FIRECLAY BRICK — Per M.: First quality, $43@$46, *Ohio, Kentucky, Central Pennsylvania;* second quality, $35@$38.

MAGNESITE—Brick, per net ton, f.o.b. works: 9-in. straights, $65. Cement, $40, seaboard.

SILICA BRICK—Per M., *Pennsylvania* and *Ohio,* $43; *Alabama,* $51; *Illinois,* $52.

ZIRKITE—Per lb.; Powdered, 65@70 per cent ZrO_2, 3½c. Brick, straights, 80c.@$1 each.

Metal Statistics

Monthly Average Prices of Metals

Silver

	New York		London Spot		Sterling Exchange	
	1928	1929	1928	1929	1928	1929
January	57.135	57.019	26.313	26.257	487.098	484.577
February	57.016	56.210	26.205	25.904	487.008	484.787
March	57.245	56.346	26.329	26.000	487.558	484.776
April	57.395	.....	26.409	.....	487.785	.....
May	60.298	.....	27.654	.....	487.685	.....
June	60.019	.....	27.459	.....	487.565	.....
July	59.215	.....	27.262	.....	485.923	.....
August	58.880	.....	27.096	.....	484.979	.....
September	57.536	.....	26.440	.....	484.654	.....
October	58.087	.....	26.727	.....	484.584	.....
November	57.953	.....	26.704	.....	484.492	.....
December	57.335	.....	26.349	.....	484.698	.....
Year	58.176	.....	26.746	.....	486.169	.....

New York quotations, cents per ounce troy, 999 fine. London, pence per ounce, sterling silver, 925 fine.

Copper

	New York	London Spot			
	Electrolytic	Standard		Electrolytic	
	1928	1929	1928	1929	1928	1929
January	13.854	16.603	61.912	75.551	66.575	78.602
February	13.823	17.727	61.670	78.228	66.381	83.538
March	13.845	21.257	61.148	89.153	66.443	98.356
April	13.986	.....	61.678	.....	66.500	.....
May	14.203	.....	62.554	.....	67.216	.....
June	14.527	.....	63.664	.....	68.738	.....
July	14.527	.....	62.881	.....	68.670	.....
August	14.526	.....	62.472	.....	68.750	.....
September	14.724	.....	63.522	.....	69.800	.....
October	15.202	.....	65.524	.....	71.935	.....
November	15.778	.....	68.080	.....	74.750	.....
December	15.844	.....	69.336	.....	75.000	.....
Year	14.570	.....	63.703	.....	69.230	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London			
	1928	1929	1928	1929	1928 Spot	1928 3 Mos.	1929 Spot	1929 3 Mos.
January	6.500	6.650	6.280	6.498	21.773	22.213	22.111	22.344
February	6.325	6.853	6.069	6.739	20.283	20.747	23.128	23.156
March	6.000	7.450	5.805	7.348	19.938	20.352	25.409	25.591
April	6.100	.....	5.991	.....	20.306	20.563	.....	.....
May	6.123	.....	6.012	.....	20.483	20.813	.....	.....
June	6.300	.....	6.152	.....	20.985	21.211	.....	.....
July	6.220	.....	6.038	.....	20.602	20.957	.....	.....
August	6.248	.....	6.056	.....	21.634	21.628	.....	.....
September	6.450	.....	6.286	.....	22.050	21.769	.....	.....
October	6.500	.....	6.318	.....	22.082	21.796	.....	.....
November	6.389	.....	6.222	.....	21.239	21.469	.....	.....
December	6.495	.....	6.343	.....	21.342	21.730	.....	.....
Year	6.305	.....	6.131	.....	21.060	21.271	.....	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Tin

	New York		London	
	1928	1929	1928	1929
	Straits		Spot	
January	55.650	49.139	253.222	222.727
February	52.440	49.347	233.833	223.138
March	52.220	48.870	232.722	220.781
April	52.270	.....	234.204	.....
May	51.582	.....	230.886	.....
June	47.938	.....	217.280	.....
July	47.040	.....	212.449	.....
August	46.012	.....	212.847	.....
September	48.073	.....	215.663	.....
October	48.966	.....	222.005	.....
November	50.750	.....	232.875	.....
December	50.185	.....	227.586	.....
Year	50.427	.....	227.131	.....

New York quotations, cents per pound. Quotations on 99 per cent tin discontinued on April 1, because of absence of business. London, pounds sterling per long ton.

Zinc

	St. Louis		London			
	1928	1929	1928 Spot	1928 3 Mos.	1929 Spot	1929 3 Mos.
January	5.643	6.350	26.125	26.051	26.196	26.233
February	5.551	6.350	25.518	25.506	26.247	26.347
March	5.624	6.463	25.082	24.960	27.050	27.294
April	5.759	.....	25.493	25.316	.....	.....
May	6.026	.....	26.102	25.756	.....	.....
June	6.158	.....	25.664	25.429	.....	.....
July	6.201	.....	24.946	24.972	.....	.....
August	6.249	.....	24.540	24.713	.....	.....
September	6.250	.....	24.497	24.625	.....	.....
October	6.250	.....	24.030	24.296	.....	.....
November	6.263	.....	24.801	24.827	.....	.....
December	6.349	.....	26.609	26.615	.....	.....
Year	6.027	.....	25.284	25.256	.....	.....

St. Louis quotations, cents per pound. London pounds sterling per long ton.

Antimony, Quicksilver and Platinum

	Antimony (a)		Quicksilver (b)		Platinum (c)			
					Refined		Crude	
	New York		New York		New York			
	1928	1929	1928	1929	1928	1929	1928	1929
Jan.	10.863	9.558	123.620	119.481	79.280	70.000	69.280	60.000
Feb.	10.842	9.548	121.370	119.818	84.783	70.000	74.783	60.000
March	10.083	9.531	122.557	121.904	80.000	70.000	70.000	60.000
April	9.865	.....	123.740	.....	80.000	.....	70.000	.....
May	11.019	.....	123.173	.....	78.000	.....	68.000	.....
June	9.750	.....	122.423	.....	78.000	.....	68.000	.....
July	9.540	.....	121.260	.....	78.000	.....	68.000	.....
Aug.	10.181	.....	124.500	.....	78.000	.....	68.000	.....
Sept.	10.813	.....	128.000	.....	78.000	.....	68.000	.....
Oct.	10.841	.....	125.923	.....	78.000	.....	68.000	.....
Nov.	10.109	.....	123.000	.....	76.417	.....	66.418	.....
Dec.	9.748	.....	122.500	.....	74.480	.....	64.480	.....
Year	10.305	.....	123.506	.....	78.580	.....	68.580	.....

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. Prior to June, 1927, the unit had been the 75-lb. flask. (c) Platinum in dollars per ounce.

Pig Iron, Valley[1], and Aluminum

	Bessemer		Basic		No. 2 Foundry		Aluminum	
	1928	1929	1928	1929	1928	1929	1928	1929
Jan.	17.50	18.00	17.00	17.50	17.25	17.50	24.300	24.300
Feb.	17.50	18.00	17.00	17.50	17.25	17.50	24.300	24.300
March	17.50	18.19	17.00	17.62	17.25	17.69	24.300	24.300
April	17.50	.....	17.00	.....	17.25	.....	24.300	.....
May	17.37	.....	16.38	.....	17.24	.....	24.300	.....
June	17.00	.....	15.56	.....	16.79	.....	24.300	.....
July	17.00	.....	15.75	.....	16.69	.....	24.300	.....
Aug.	17.00	.....	15.75	.....	16.50	.....	24.300	.....
Sept.	17.00	.....	15.75	.....	16.50	.....	24.300	.....
Oct.	17.24	.....	16.66	.....	16.74	.....	24.300	.....
Nov.	17.82	.....	17.32	.....	17.32	.....	24.300	.....
Dec.	18.00	.....	17.50	.....	17.50	.....	24.300	.....
Year	17.37	.....	16.56	.....	17.02	.....	24.300	.....

Iron in dollars per long ton. Aluminum in cents per pound, 99 per cent grade.
[1]F.o.b. Mahoning and Shenango valley furnaces; freight to Pittsburgh, $1.76.

Monthly Crude Copper Output in Short Tons

Domestic

	1928					1929	
	Sept.	Oct.	Nov.	Dec.	Total	Jan.	Feb.
Alaska shipments	661	3,036	1,313	1,807	22,724	2,145	913
Calumet & Arizona	2,337	2,201	3,006	2,890	27,177	2,150	2,551
Magma	1,678	1,877	1,635	1,436	18,251	1,730	1,450
Miami	1,770	2,133	2,119	2,148	24,129	2,262	.....
New Cornelia	3,230	3,190	3,340	4,143	40,020	3,104	3,002
Nevada Con.	†35,476	.....	.....	†40,613	134,231	.....	.....
Old Dominion*	818	840	943	804	11,069	921	734
Phelps Dodge††	7,892	10,054	9,080	10,361	103,621	9,850	9,537
United Verde Extens.	1,757	2,065	2,133	2,344	22,073	2,338	2,024
Utah Copper	†35,858	.....	.....	†42,956	136,920	.....	.....
Tennessee Copper	594	621	639	558	6,782	597	616
Foreign							
Andes Copper	4,925	6,180	7,835	6,890	53,207	7,485	.....
Braden	8,193	9,265	10,438	4,740	110,888	6,510	.....
Boleo, Mexico	†3,053	.....	.....	†3,422	12,782	.....	.....
Bwana M'Kubwa	556	530	533	649	6,696	812	605
Chile	11,336	14,368	14,080	15,380	134,661	15,645	.....
Furukawa, Japan	1,661	1,547	1,396	1,468	17,865	1,420	.....
Granby Cons., Canada	2,445	2,447	2,359	2,465	28,767	2,677	2,324
Howe Sound	†5,039	.....	.....	†5,490	21,099	.....	.....
Mount Lyell, Australia	†2,274	.....	.....	†1,204	6,582	.....	.....
Sumitomo, Japan	1,677	1,466	1,562	1,660	17,898	1,502	.....
Union Miniere, Africa	10,248	10,120	10,174	9,440	123,880	9,753	9,477

†Three months. *Includes Arizona Commercial.
††Mocteruma is included.

Monthly Production of Primary Copper from U. S. Mines and Daily Rate (Short Tons)

	1927		1928		1929	
	Monthly Production	Daily Rate	Monthly Production	Daily Rate	Monthly Production	Daily Rate
January	76,198	2,458	68,469	2,209	86,325	2,785
February	69,202	2,472	67,423	2,352	84,769	3,027
March	69,314	2,236	70,327	2,269	.....	.....
April	71,122	2,371	69,721	2,324	.....	.....
May	71,613	2,310	73,729	2,378	.....	.....
June	69,539	2,318	73,224	2,441	.....	.....
July	65,545	2,114	73,426	2,369	.....	.....
August	67,248	2,169	76,952	2,482	.....	.....
September	65,936	2,198	78,341	2,611	.....	.....
October	68,545	2,225	86,480	2,790	.....	.....
November	68,080	2,269	85,382	2,846	.....	.....
December	67,377	2,173	85,673	2,764	.....	.....
Total	829,878	.....	909,147	.....	171,094	.....
Monthly average	69,165	.....	75,762	.....	85,547	.....
Average of daily rate	.....	2,274	.....	2,484	.....	2,900

Mining Stocks—Week Ending March 30, 1929

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	166	142	159½	Mr.29,My.20 Q	1.75
Anaconda, new	New York	135¾	120½	133		
Andes Copper	New York	62¼	51	58¾	Mr.29, My.6 Q	0.75
Arizona Com	Boston	4½	3⅜	4	Ja. 16, Ja. 31 S.A.	0.25
Calumet & Ariz	New York	136	121½	133	Mr.7, Mr.25 Q	1.50
Calumet & Hecla	Boston	56½	42	53	Fe. 28, Mr. 30 Q	1.00
Cerro de Pasco	New York	110¾	100½	108	Ja. 11, Fe. 1 Q	1.25
Chile Copper	New York	121	105⅜	116½	Mr.22, Ap.22 Q	0.87½
Con. Coppermines	N. Y. Curb	16⅜	13⅜	16		
Copper Range	Boston	31½	26⅛	29	Mr.15, Ap.15 Q	0.50
East Butte	Boston	4¾	4½	4¾	Dec., 1919	0.50
Granby Con	New York	99¾	81	98½	Ap.12, My.1 Q	1.75
Greene Cananea	New York	183	152⅜	175½	Mr. 7, Ap. 1 Q	2.00
Howe Sound	New York	79½	70	77	Mr. 30, Ap. 15 Q	1.00
Hudson Bay	N. Y. Curb	19½	18⅜	19½		
Inspiration	New York	60⅜	45⅜	56⅜	Mr.14, Ap. 1 Q	1.00
Isle Royale	Boston	33	28¼	31½	Fe. 28, Mr.30 X	0.50
Kennecott	New York	95¾	82	94	No. 30, Ja. 2 Q	2.00
Magma Copper	New York	79½	68½	75⅜	Mr.30, Ap.16 Q	1.25
Mason Valley	N. Y. Curb	1⅜	1½	1⅜		
Miami Copper	New York	50⅜	35⅜	49	Fe 1, Fe.15 Q	0.50
Mohawk	Boston	55⅜	52	53½	Ja. 26, Mr. 1 Q	1.50
Mother Lode	New York	5½	4½	5	De.14, De.31 SA	0.20
Nevada Con	New York	57½	44⅜	56⅜	Mr.15, Mr.30 Q	0.75
New Cornelia	N. Y. Curb	45½	41	45⅜	Fe. 1, Fe. 18 Q	0.50
Noranda	N. Y. Curb	58½	45⅜	56½		
Ohio Copper	N. Y. Curb	3⅜	2⅜	3	Sept., 1926	0.03
Old Dominion	Boston	16½	13	13	Dec., 1918	1.00
Phelps Dodge	N. Y. Curb	83	76½	80½	Mr. 15, Ap. 1	2.50
Quincy	Boston	44	38½	41½	March, 1920	1.00
Roan Antelope	N. Y. Curb	44½	42	43⅜		
St. Mary's M. L	Boston	44½	39	41	Fe.25, Mr.12	2.00
Seneca Copper	New York	9⅜	6⅜	9½		
Shattuck Denn	N. Y. Curb	23⅜	20⅜	22½		
Sherritt-Gordon	Toronto	8.50	7.00	8.50		
Tenn. C. & C	New York	18⅜	16½	18⅜	Fe.28, Mr.15 Q	0.25
United Verde Ex	N. Y. Curb	22	19½	22	Ap. 4, My. 1 Q	1.00
Utah Copper	New York	....	....	345	Mr. 15, Mr. 30 Q	3.00
Waite-Ack.-Mont	Toronto	1.50	1.50	1.50		
Walker Mining	Salt Lake	4.25	3.90	4.00		
Wenden Copper	N. Y. Curb	1⅞	1½	1⅞		
LEAD, ZINC, SILVER						
Ahumada Lead	New York	4	3½	3⅜		
Amer. Z. L. & S	New York	43⅜	30⅜	40⅜	May, 1917	1.00
A. Z. L. & S., pfd	New York	105	98¼	101	Nov., 1920	1.50
Bingham Mines	Boston	51½	51½	51½	Mr.15, Ap.5	0.50
Bunker Hill & S	N. Y. Curb	160	155	160	Fe.28, Mr.5 X	0.75
Butte Cop. & Zn	New York	8¼	7	7½		
Butte Cop. Con	Boston Curb	*79	*75	*76		
Butte & Sup	New York	9½	8½	9	Mr. 15, Mr. 30 Q	0.50
Callahan Zn-Ld	New York	3¼	3	3⅛	Dec., 1920	0.50
Chief Consol	Salt Lake	3.60½	3.52½	3.52½	Fe. 1, 1928 K	0.10
Consol. Ld. & Zn. "A"	St. Louis	13½	12⅜	12⅜	Ap.5, Ap.10	0.25
Constitution	Spokane	*39	*34	*37		
Dayrock	Spokane	2.50	2.00	2.35	Mr.23, Mr.30	0.03
Dickens Consol	Spokane	*13½	*8⅞	*10		
Eagle-Picher	Cincinnati	19¾	18⅜	18¾	Mr.31, Ap.15 Q	0.20
Eagle-Pich., pfd	Cincinnati	....	....	102	Jan. 15 Q	1.50
Erupcion	Boston Curb	....	....	*22	Ja. 1, 1928 Q	0.07½
Eureka Bullion	Salt Lake	*94	*83	*92		
Eureka Lily	Salt Lake	....	....	1.42½		
Eureka Standard	Salt Lake	4.70	4.70	4.70		
Evans-Wallower	N. Y. Curb	19½	14½	17⅞		
Evans-Wal., pfd	N. Y. Curb	81½	81½	81½	Mr.20, Ap.1 Q	1.75
Federal M. & S	New York	266	266	266	Je., 1927	10.00
Fed. M. & S., pfd	New York	98½	98½	98½	Fe. 21, Mr. 15 Q	1.75
Gladstone	Spokane	*13½	*12⅜	*13½		
Golconda	Spokane	1.14	1.10	1.10	Mr.20, Ap.1 Q	0.02
Grandview	Spokane	*56½	*49	*49		
Hecla Mining	N. Y. Curb	21	20	20⅜	Fe.15, Mr.15 M	0.15
Highland-Surprise	Spokane	*16¼	*15	*15		
Jack Waite	Spokane	*14	*12	*12		
Kootenay Florence	Spokane	*16½	*15	*15½		
Lucky Jim	Spokane	*20	*17	*20		
Lucky Tiger-C	Kansas City	†5.75	15.40	....	De.4, De.20 MX	0.12
Mexican Premier	Spokane	1.76	1.37	1.76		
National Lead	New York	163	145	160	Mr. 15, Mr. 31 Q	1.25
Natl. Lead, pfd. A	New York	141½	140	140	Mr. 1, Mr. 15 Q	1.75
Natl. Lead, pfd. B	New York	....	....	118	Ap. 19, My 1 Q	1.50
N. J. Zinc	N. Y. Curb	308	302	306	Ja.19, Fe.2	2.00
N. J. Zinc, new	N. Y. Curb	79	75⅜	79		
New Quincy	Salt Lake	3.10	2.60	2.90		
Noble Five	Spokane	*76	*71	*76		
North Lily	Salt Lake	9.75	9.50	9.50	Jan. 20 Q	0.25
Park Bingham	Salt Lake	11	10	*11		
Park Utah	New York	11⅜	10	10⅜	Mr. 19, Ap. 10 Q	0.20
Pend Oreille	Spokane	12.50	8.25	12.50		
Rico Argentine	Salt Lake	*49	*48	*48	No. 30, De. 15 Q	0.03
Ruth-Hope	Spokane	*48	*42	*46		
St. Joseph Lead	New York	79½	64¾	75	Ju. 8, Ju.20 QX	0.75
Sherman Lead	Spokane	*36	*33½	*33½		
Silver King Coa	Salt Lake	16.00	14.50	15.00	Mr. 20, Ap. 1 Q	0.25
Silversmith	Spokane	*12½	*11⅛	*11⅛	Oct., 1926 Q	0.02
Sunshine Mining	Spokane	1.68	1.58	1.60	De. 20, BM	0.02
Tamarack-Custer	Spokane	*71	*63	*66	Sept., 1924	0.25
Tintic Standard	Salt Lake	15.50	15.00	15.00	De. 23, Ja. 23 X	0.20
Tonopah Belmont	N. Y. Curb	..	..	*90	Oct., 1925	0.05
Treadwell-Yukon	Toronto	13	11	11½		
United Zinc Smg	N. Y. Curb	..	..	1½		
Utah Apex	Boston	6	5½	5⅛	Je. 14, Au. 1 K	0.25
Utah Met. & Tun	Boston	2	1⅛	1⅛	Dec., 1917	0.30
Whitewater	Spokane	1.15	1.00	1.10		
Yellow Pine	Los Angeles	*24	*18	*18	Dec., 1925 QX	0.04
GOLD						
Alaska Juneau	New York	7½	5⅜	7½		
Barry-Hollinger	Toronto	*30½	*25	*30		
Central Manitoba	Toronto	*52	*37	*48½		
Coniaurum	Toronto	*45	*45	*45		
Creeson Consol	N. Y. Curb	*95	*76	*90	Mr.30, Ap.10 Q	0.02
Dome Mines	New York	9⅞	8¼	9¼	Mr.30. Ap..20 Q	0.25
Golden Cycle	Col. Springs	†1.63	†1.61	....	Fe.15, Mr.1	0.04
Gold Hill	Toronto	*6	*4	*6		
Hollinger	Toronto	7.50	6.85	7.25	Ap.5, Ap.22 M	0.05
Homestake	New York	74¼	73½	73½	Mr.20, Mr.25 M	0.50
Kirland Lake	Toronto.	1.22	*95	1.22		
Lake Shore	Toronto	24½	20⅜	24	Mr.1, Mr.15 Q	0.20
McIntyre-Porc	New York	19⅜	19½	19½	Fe.1, Mr.1 Q	0.25
Portland	Colo. Springs	†*12	†*9½	....	April, 1927	0.02
Rand Mines	New York	....	....	36½	Fe. 21,'28 Am.Sh.	1.52
Siscoe	Toronto	*93	*48½	*80		
Sylvanite	Toronto	1.80	1.62	1.70		
Teck-Hughes	Toronto	9.00	8.00	8.95	Ja. 31, Fe. 1 Q	0.15
Tom Reed	Los Angeles	*20	*15	*15	Dec., 1926	0.02
Unity Gold	N. Y. Curb	1	*82	1		
Vipond Consol	Toronto	1.09	*84	1.07	April, 1927	0.03
Wright-Hargreaves	Toronto	1.90	1.60	1.90	Oc. 16, No. 1	0.02½
Yukon-Alaska	N. Y. Curb	....	....	35⅜		
GOLD AND SILVER						
Carnegie Metals	N. Y. Curb	18	18	18		
Castle-Trethewey	Toronto	*35	*34	*34		
Consol. Cortez	N. Y. Curb	....	....	*16		
Dolores Esperanza	N. Y. Curb	1	*83	1	July, 1923	0.05
Keeley	Toronto	*40	*40	*40	Mr.15, 1928	0.04
Mining Corp	Toronto	5.10	3.90	5.10	De.14,De.31 SA	0.15
Montana-Idaho	Spokane	*15½	*11⅜	*15		
N. Y. & Hond. Ros	N. Y. Curb	17	17	17	Ja.16, Ja.26 QX	0.50
Nipissing	N. Y. Curb	....	....	3	Mr.30,Ap.20 Q	0.07½
Premier Gold	N. Y. Curb	1⅜	1⅜	1⅜	Mr.14, Ap.4	0.06
Tonopah Exten	N. Y. Curb	....	....	*10	April, 1925	0.05
Tonopah Mining	N. Y. Curb	3⅜	3⅜	3⅜	Ap. 7, Ap. 20	0.07½
United Eastern	N. Y. Curb	*91	*70	*70		
Yukon Gold	N. Y. Curb	....	....	*76	June, 1918	0.02
IRON AND STEEL						
Bethlehem Steel	New York	105	*95	104½	Fe. 15, R	1.00
Beth. Steel, pfd, 7%	New York	119½	116¾	119	Mr.4, Ap.1 Q	1.75
Cleveland-Cliffs	Cleveland	205	105	195	Ap.15, Ap.25 Q	1.00
Colo. Fuel & Iron	New York	68⅜	59	65¼		
Colorado F. & I., pfd	New York	....	....	133	Fe.11, Fe.25 Q	2.00
Great Northern Iron	New York	32½	31½	32½	Dec.15, K	2.00
Inland Steel	New York	93½	86	91	Fe. 15, Mr. 1, Q	0.87½
Republic I. & S	New York	93	82½	91	Fe. 13, Mr. 1, Q	1.00
Republic I. & S., pfd	New York	110	109	109	Mr.11, Ap. 1, Q	1.75
Sloss-Sheffield S. & I	New York	....	....	115½	Mr. 11, Mr 20, Q	1.50
Sloss-Sheff. S. & I., pfd.	New York	....	....	108	Mr.20, Ap.1, Q	1.75
U. S. Steel	New York	183¾	171½	183⅜	Fe. 28, Mr. 30, Q	1.75
U. S. Steel, pfd	New York	143½	141	141	Fe 2, Fe. 27, Q	1.75
Virginia I. C. & C	New York	....	....	23	Jan., 1924	1.50
Virginia I.C.& C., pfd.	New York	45	45	45	Jl.16, 1928 SA	2.50
MISCELLANEOUS						
Aluminum Co. of Am.	N. Y. Curb	167	155	160		
Alum.Co.of Amer., pf.	N. Y. Curb	106	106	106	Mr.15, Ap.1, Q	1.50
American Metal	New York	65½	52½	64	Fe.9, Mr.1 Q	0.75
Amer. Metal, pfd., 6%	New York	121	120½	120½	Fe.9, Mr.1, Q	1.50
Amer. Sm. & Ref	New York	114¾	102	113½		
Amer. Sm. & Ref., pfd.	New York	136	135½	135½	Fe. 1, Mr. 1 Q	1.75
Ang. Ch. Nitrate	N. Y. Curb	44¼	39½	44½		
Asbestos Corp	Montreal	14	11	13½	Jan. 1926	1.50
Asbestos Corp., pfd	Montreal	45	45	45	De. 31, Ja. 15 Q	1.75
Consol. M. & S	Montreal	465	395	440	De.31,Ja.15,SAX	6.25
De Beers Consol	New York	....	....	22½	Ja. 19, Ja.26,	0.48
Federated Metals	N. Y. Curb	36½	32½	35½	Mr.27, Ap.5 Q	0.75
Freeport Texas	New York	48	38	47	Ap. 5, My. 1 Q	1.00
Int. Nickel Can	New York	52¼	40½	52	Mr.16, Mr.30 Q	0.20
Int. Nickel, pfd	New York	....	....	128	Ap.2,My.1 o.1Q	1.75
Newmont	N. Y. Curb	214¾	194½	209½	Mr.30, Ap.15 Q	1.00
Patiño M. & E	New York	45	38⅜	45½	Aug. 1928	4s
So. America G. & P	N. Y. Curb	2⅜	2½	2⅜		
Texas Gulf Sulphur	New York	80⅜	72½	80½	Mr.4, Mr.15 Q	1.00
U. S. Sm. R. & M	New York	67½	57½	67½	Ap. 4, Ap. 15 Q	0.87½
U. S. Sm. R. & M., pfd.	New York	54	53½	53½	Ap. 4, Ap. 15 Q	0.87½
Vanadium Corp	New York	98½	83½	95½	Fe.1, Fe. 15 Q	0.75

Toronto Standard Stock Exchange, Toronto, courtesy Arthur E. Moysey & Co.; Salt Lake Stock Exchange, courtesy J. A. Hogle & Co. and Logan & Bryan, New York; Spokane Stock Exchange, courtesy Pohlman Investment Company.

*Cents per share. †Bid or asked. Q, Quarterly. A. Annually. SA, Semi-annually. M, Monthly. BM, Bimonthly. FW, Four weeks. K, Irregular. I, Initial. R, Resumprion. X, Extra. The first data given is that of the closing of the books; the second that of the payment of the dividend.

LONDON QUOTATIONS—WEEK ENDED MARCH 19, 1929

	High	Low	Last	Date	Amount
Alaska Mexican ($5)	20/—	20/—	20/—		
Alaska Treadwell (25)	65/—	62/6	62/6	Nov., 1926	4 (d)
Armayo Mines (25 frs.)	67/6	66/3	67/6	Feb. 1929	5 (c)
Burma Corp (10 rupees)	19/6	16/9	18/9	Feb., 1929	7 annas*
Bwana M'Kubwa (5s)	21/—	18/9	20/3		
Camp Bird (2s)	3/—	2/6	2/9	April, 1928	1½
El Oro (£1)	5/—	4/3	4/9	Nov., 1924	2½*
Frontino & Bolivia (£)	9/—	8/7½	8/9	Jan., 1929	3½
International Nickel of Canada (no par value)	$64	$60½	$61½	Mar., 1929	20(c)
Mexican Corpn. (£1)	11/4½	9/6	11/3		
Mexican Mines of El Oro (£1)	10/—	7/6	10/—	Dec., 1926	3½*
Mount Isa (£)	43/9	39/4½	43/9		
N'Changa Copper Mining. (£1)	90/—	81/3	88/9		
Oroville Dredging (4s)	2/9	2/6	2/9	Nov., 1928	3½
Rhodesian Congo Border (£1)	159/—	116/3	157/6		
St. John del Rey (£1)	15/6	14/3	15/—	Dec., 1928	2½
San Francisco Mines (10s)	40/3	34/6	38/9	Jan., 1929	25
Santa Gertrudis (£1)	10/7½	9/9	10/3	Jan, 1929	7½
Selukwe (2s. 6d.)	7/3	6/9	7/—	April, 1917	6¼
S. Amer. Copper (2s.)	3/9	3/1½	3/7½	Nov. 1917	75
Tanganyika (£1)	74/—	68/9	73/1½	July, 1928	5
Union Miniere de Haut-Katanga (Brussels)	12,850	12,500	12,750	July, 1928	182.60‡

*Free of British income tax. †Swiss francs and plus 15 p. c. bonus. ‡Belgian frs. and free of taxation.

(Price quoted in dollars with a fixed rate of $5 to the £1)